SULPHUR

The Magazine of World Sulphur Industry

No. 22 *SEPTEMBER*, 1958

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end 1957	70,000 *tons*
end 1958	350,000 *tons*
end 1959	700,000 *tons*
end 1960	1,000,000 *tons*
end 1961	1,300,000 *tons*

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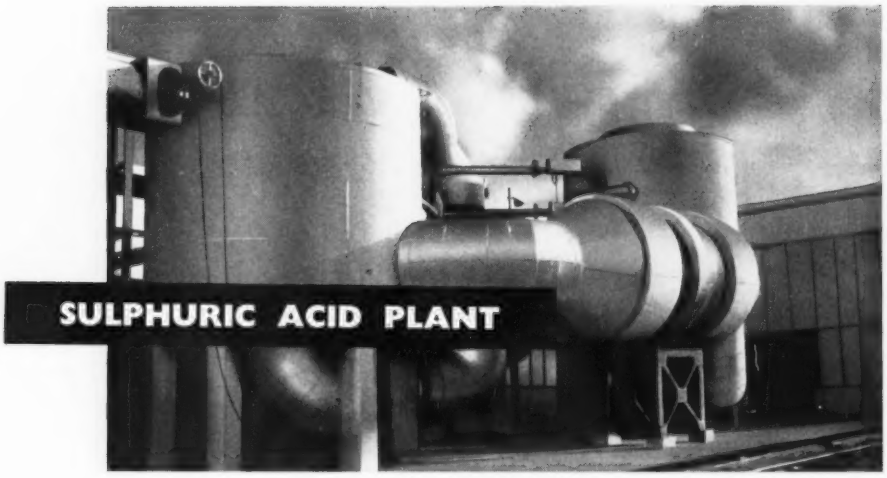

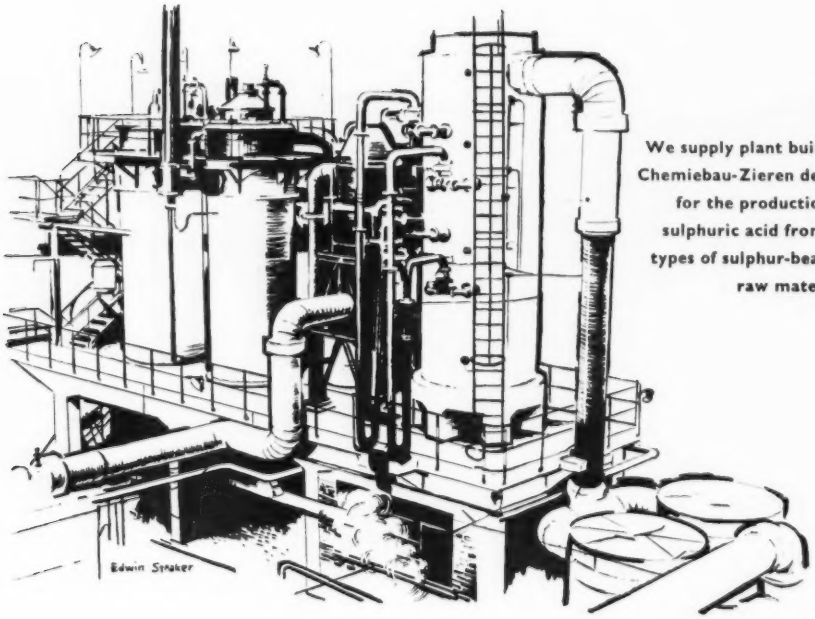

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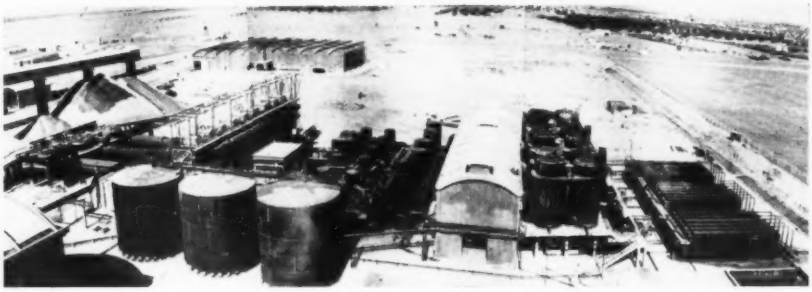

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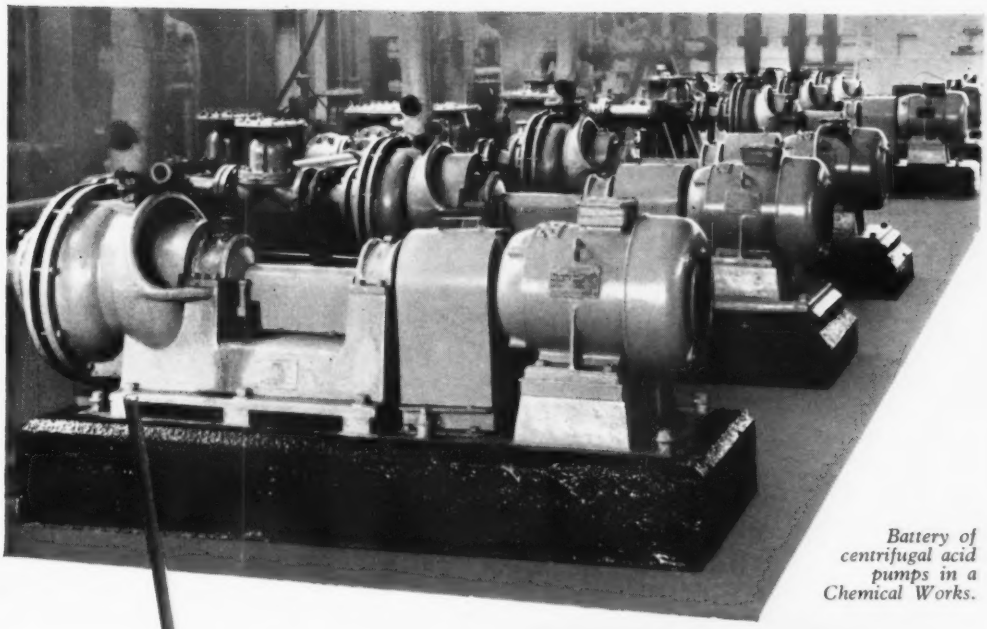

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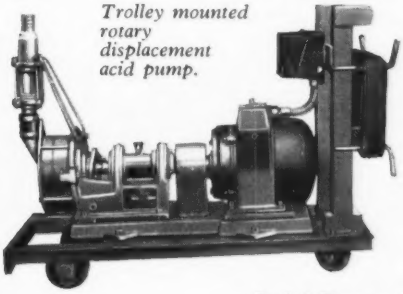

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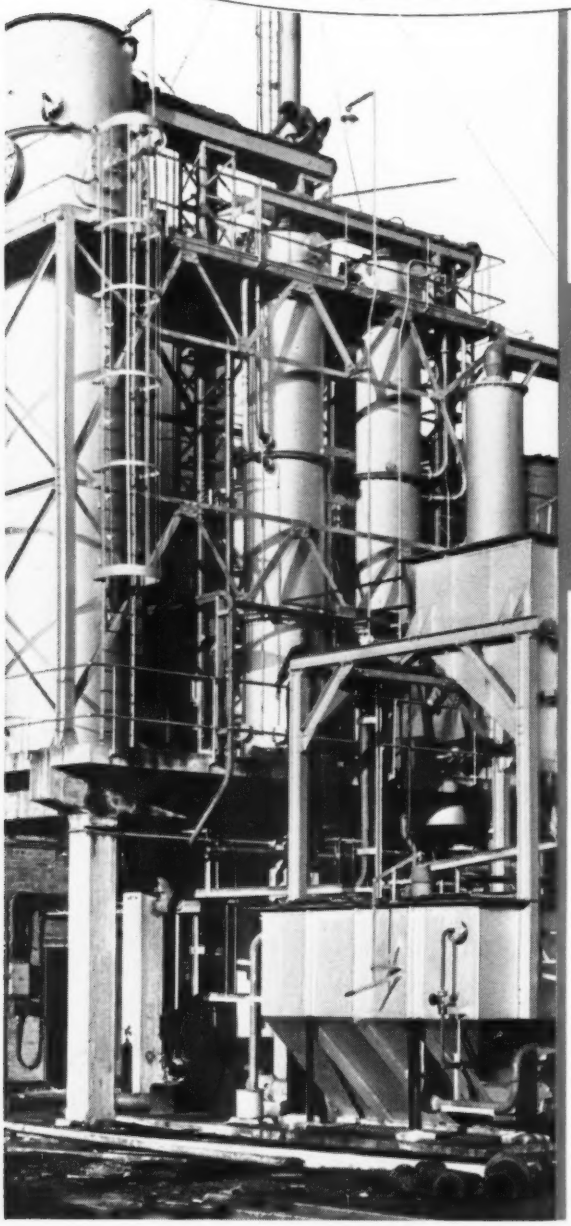

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Foreword

In March 1956 we established a Technical Consultancy Service to deal with the increasing flow of enquiries on technical subjects. The Service aimed at providing from a central focus a wide choice of expert and impartial advice on technical problems relating to the production and consumption of sulphur in all forms, including critical examination of new projects and processes and advice on production methods.

The response over the past two years has been so encouraging that we have found it expedient to review, reorganise and expand the Consultancy Service to embrace a much wider field than hitherto has been possible. Our standing panel of consultants has been fortified by the addition of the services of :—

Messrs. L. H. Manderstam & Partners; Consulting Engineers and

Messrs. O. W. Roskill Industrial Consultants; Engineers, Chemists and Economists.

The scope of the service which we can now offer is much enlarged and embraces all technical and economic aspects of mining, treatment and use of sulphur in all forms of industry. The service extends from specific queries on individual problems to the economic evaluation of new projects and processes and the planning of new plants. All work undertaken by the Corporation is treated as confidential. Results and patent rights arising from experimental work are the exclusive property of the client.

It is opportune to remind readers that the object of the British Sulphur Corporation is to provide reliable information and advice on all aspects of the sulphur industry throughout the world and to do so in an impartial manner irrespective of the origin or form of sulphur production or of the ultimate use.

Review

World prices of brimstone have steadied and one of the main contributory factors has been the restraint shown by the producers of Mexican sulphur in their pursuit of new business. The growing practice of recent months to quote "delivered" prices, however, increasingly detracts from the significance of posted f.o.b. prices which are based on $25 per ton for U.S. bright Frasch sulphur. The reduction of European pyrites export prices to between 67s. 6d. and 77s. 6d. per metric ton f.o.b. has improved their competitive position vis-à-vis brimstone. The benefits to consumers of the low cost of sulphur are enhanced by the continued low level of sea freight.

World production and capacity of Frasch and recovered sulphur continue expanding more rapidly than demand. World stocks of brimstone are rising and are now estimated to total six million tons. Exports of European pyrites have slackened in contrast with deliveries to domestic users in the main pyrites producing countries. The overall statistical position of sulphur is progressively weakening and the rapid growth of sulphur recovery prompts an urgent assessment of the most profitable level of operation of Frasch sulphur producers.

The Sulphur Industry of France looks forward to 1961 when the recovery of 1.4 million tons high quality brimstone from the natural gas production at Lacq will make her a leading power in world sulphur markets. Last year, when the first unit of the recovery plant started operating, yearly domestic production based predominantly on sulphur in pyrites and industrial gases—metal smelter, coal and oil refinery—totalled about one-quarter million tons. Consumption, sustained by imports of Mexican and U.S. brimstone and of pyrites totalled 760,000 tons sulphur in all forms, of which 160,000 tons were used in viticulture and other non-acid uses and 600,000 tons in sulphuric acid production. Two producers, Cie de St. Gobain and Ets. Kuhlmann, account for 60% of acid output of which one-half is taken up for fertilizers, notably superphosphate manufacture. The stimulus of economic supplies of Lacq natural gas and sulphur could carry the expansion of the French chemical industry beyond the ambitious targets which have already been set.

The projected installation in **Cuba** of the world's largest sulphuric acid plant at the Freeport Sulphur Company's nickel/cobalt ore refinery at Moa Bay promises to raise the island's sulphur industry to a prominent position. Increased pyrites production for export and domestic use and expansion of sulphuric acid and fertilizer manufacture are helping to broaden the base of the island's economy.

United States sulphur production during the second quarter, in the course of which Texas Gulf Sulphur Company's Fannett dome came on stream, totalled 1,345,173 tons of Frasch and recovered sulphur, 7½% less than in the corresponding period of 1957. The reduction is principally attributable to the wish of the Frasch sulphur industry to align its operations to sales. Domestic sulphur demand was depressed by the industrial recession and late demand for fertilizers but export sales wholly controlled by the Sulphur Export Corporation rose to nearly 450,000 tons.

Sulphur production in **Mexico** in the second quarter totalled 315,424 tons of which 91% was Frasch sulphur. Exports totalling 234,441 tons, supplied by Pan American Sulphur Company (78%) and by Gulf Sulphur Corporation (22%), were destined to the United States (51%), Europe (24%) and other parts (25%). Despite its growth to over 80,000 tons per annum the Mexican domestic market is too small to constitute an outlet of sufficient magnitude to the Frasch sulphur industry, which is beginning to feel the adverse effects of over-supply in world markets at a time when it might consolidate its successful and rapid expansion of output and sales.

In the **United Kingdom** slower industrial activity made its mark on sulphur consumption which in the second quarter receded to 212,000 tons, 11% less than in the second quarter of 1957. Consumption of imported brimstone and pyrites declined most, but indigenous sulphur supplies notably of anhydrite were much less affected. Sulphuric acid production of 531,919 tons represented the employment of only 76.4% of the useful capacity. Consumption of sulphuric acid was 7½% lower than in the corresponding period of 1957 and, with the exception of soaps, detergents and plastics, all uses, even fertilizers and titanium oxide, showed a decline. The continued cheap sulphur imports afford a good opportunity for the industry to lower its costs.

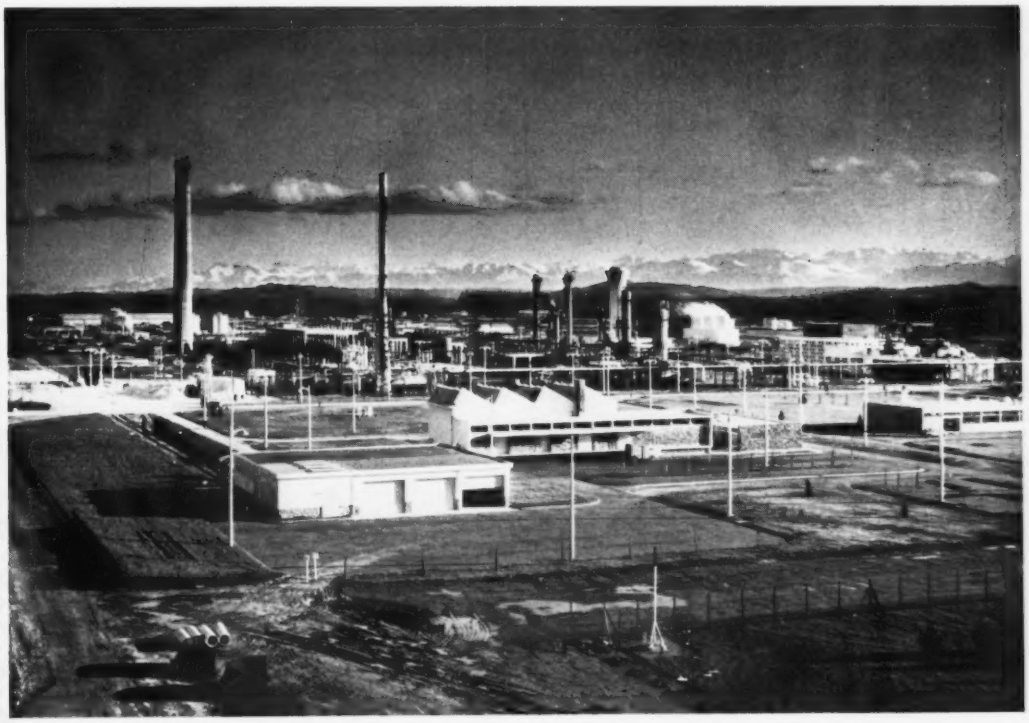
Production and exports of iron and copper pyrites from **Cyprus** in 1957 remained near the peak level of close on one million tons, but lower sulphur and copper prices depressed the mining companies' revenue.

The sulphur industries of the Sino-Soviet **Communist Countries,** whose aggregate output in 1958 is estimated at three million tons sulphur in all forms and seven million tons sulphuric acid, are expanding rapidly. Known sulphur resources in the form of pyrites, sulphide and native sulphur ores are substantial, and official claims, if substantiated, would make them the largest in the world. Production of sulphuric acid and fertilizers, which are prominent features of the respective five-year plans, is to expand at rates far exceeding similar development in the Free World, especially in China where hitherto the West exported substantial quantities of sulphur in the form of fertilizers. In making provision to meet their own great sulphuric acid and fertilizer needs, the Soviet-Bloc countries are also forging a powerful politico-economic weapon.

Sulphur in France

THE SPECTACULAR development of sulphur recovery facilities in conjunction with large-scale exploitation of the natural sour gas field of Lacq in South-West France, places the French sulphur industry in a decisive position amongst the world suppliers of brimstone and opens the door to what might well prove to be the most significant period in its long and influential history. Hitherto, its activities have been conditioned by the need to import a major part, and at times all, of its sulphur requirements. Prominence in technical achievements has also tended to be confined to the consumption sector of the industry. In sulphuric acid manufacture, French processes and plant features are household words and similarly in the refining of sulphur and development of agricultural sulphur the French industry has been outstanding.

Prior to the start of sulphur recovery operations at Lacq, the level of established indigenous sulphur supply was about 250,000 tons, representing about one-third of the industry's requirements. Domestic French sulphur resources have hitherto been based almost exclusively on a number of small to medium-sized deposits of iron pyrites. Intermittently the exploitation of low-grade sulphur ore deposits has helped to meet some of the sulphur needs of French viticulture, and gypsum, until recently, provided a modest annual output of sulphuric acid. Despite its large coal and iron industry, the development and use of spent ferrous oxide resulting from town gas or coke oven gas purification, have played only a small part and this aspect of the industry does not compare in size with the United Kingdom or Germany. The utilisation of sulphur in zinc smelter gases, on the other hand, plays a prominent role in supplying cheap sulphuric acid for superphosphate manufacture. The relatively slow expansion of oil



Société Nationale des Pétroles d'Aquitaine. General view of the installations at Lacq.

refinery operations in France is responsible for the small scale sulphur recovery from this source which is, however, now expanding rapidly.

The upsurge of energy supply in various forms including domestic and Sahara oil, natural gas and before long atomic power, may be said to be symptomatic of the development of France's industrial activity. In the post-war years the rate of industrial expansion in France has lagged behind that of most of her neighbours and consequently sulphur demand also rose less rapidly; moreover, severe fluctuations in fertilizer requirements which make an appreciable impact on the French sulphur picture militated against an even tenor of development. For the past 12 to 15 months whilst most major sulphur industries have been stagnating, France's has surged forward and whereas earlier the anticipated development under the Monnet Plan and the plans of the French "Chemical Industry's Commission for the Modernisation and Re-equipment" had appeared difficult of attainment, according to the latest forecasts they may well be surpassed. Under the third plan, covering the period 1957-1961, it is foreseen that general industrial activity in 1961 is to be 45% greater than in 1954 and the Gross National Product 37% greater.

The main weight of expansion in the chemical industry is, in common with the world trend, in organic chemicals but as shown by the index figures (1952 = 100) below and the envisaged level of investment, production of inorganic chemicals is also to undergo significant developments.

				*Investment**
	1954	*1956*	*1961*	
Organic ...	153	248	350	113
Inorganic ...	118	140	180	152
Other (glass & rubber) ...	113	136	160	110

*1957-1961: Milliard French Francs.

The supply of natural gas at Lacq as a source of energy and chemical raw materials plays a key role in the plans and almost every major sector of French chemical industry will be influenced by if not dependent on it. Significant targets to be reached by 1961 include the expansion of sulphuric acid capacity by about 650,000 tons (42%) gross, the rise of the index of nitrogenous fertilizer manufacture to 207 (1954 = 100) and the increase of phosphate fertilizer production by 20% to 960,000 tons per annum P_2O_5. The most far reaching impact in its particular field will, of course, be the recovery of 1.4 million tons per annum high purity brimstone at Lacq, which at home and in world markets will cause great changes in the supply and consumption pattern of sulphur.

PRODUCTION

Output of sulphur in various forms in 1957 totalled 250,000 tons, an increase of 23% over 1956 and 86% over 1948 when attention began to be focussed on improvement of indigenous sulphur supplies. As shown in Fig. 1 in 1957 recovered sulphur output at Lacq

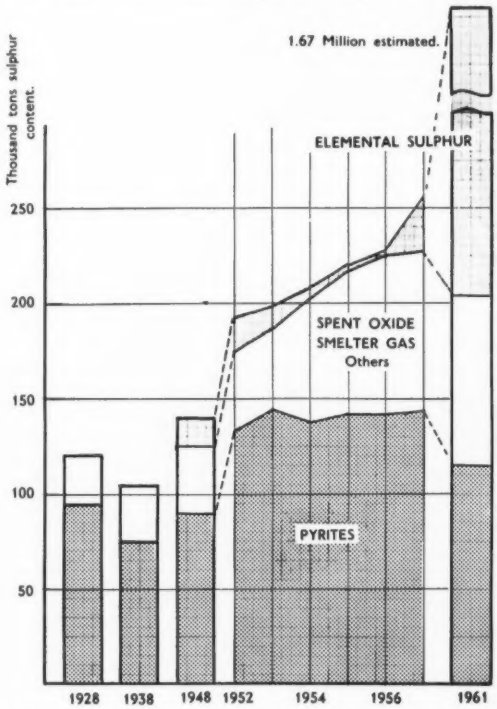


Fig. 1. Total sulphur production, thousand metric tons sulphur content.

represented only 13% of the total production whereas in three years it is expected to represent over 90% of an output six times greater than the present total.

Pyrites

Hitherto the main source of domestic sulphur supplies, pyrites production is based principally on two deposits in East Central France, Sain Bel and Chizeuil, both owned

and operated by Cie. de St. Gobain. In addition there are a number of lesser deposits of pyrites, situated mainly in the Gard region of the Pyrenees foothills, only some of which are exploited.

Output in 1957 totalled 352,000 tons pyrites concentrates, having risen to this level after the successful extensive modernisation of the St. Gobain mines in 1951.

As indicated above, prior to World War II annual production was about 150,000 tons which, after modest increases of output after the war, finally rose to 300,000-350,000 tons. An important development has been the improvement of grade since by discontinuing the supply of some lower grade crude ore and processing the entire output, Cie. de St. Gobain now provide the bulk of French domestic pyrites supply in the form of concentrates containing 48-49% sulphur.

Native Sulphur

One of the earliest sources of sulphur to be exploited in France, low grade sulphur ore, provides a small part of the French sulphur needs. There are several deposits ranging from 5-10% sulphur notably at Apt (Vaucluse), Camoins (Marseilles) and Malvezy (Narbonne). Most of the output is enriched with imported brimstone to provide annually about 3,000 tons ground sulphur of 30-48%S. At Malvezy, starting in 1941, the Soc. Languedocienne des Mines, a subsidiary of the State-controlled Potasse et Engrais Chimique, developed a sulphur ore refining process permitting the manufacture of high purity—at least 99.5%S. brimstone from ore containing less that 10%S and generally heavily contaminated by bitumen. The process comprised progressively flotation, gangue agglomeration and filtering and during and immediately following the sulphur crisis of 1950/51, there had been good prospects of installing the process in Sicily and other sulphur ore refining centres. The rapidity of improvement of world supply, coupled with the high capital cost of the plant which had only very specialised application, prevented the realisation of several projects. Peak production of 17,900 tons occurred in 1952 and in all some 87,000 tons refined sulphur, supplemented by a much larger tonnage of lower grade material for dusting and soil conditioning, originated from this source.

Sulphur in Smelter Gas

The manufacture of by-product sulphuric acid in France which attains an annual level of 185,000 tons, equivalent to 60,000 tons sulphur, is centred on the activities of the Cie Royal Asturienne des Mines. One of the leading lead and zinc mines and refineries in the world, the activities of this Belgian company are prominent in Spain, Norway and France. Here zinc blende roasting and metal refining are coupled with the manufacture of superphosphate in which the economic supply of by-product acid plant plays a decisive part. The company's works are at Tonnay-Charente and Auby, and at both plants modernisation and new installations are a testimony to their valuable contributions to French fertilizer and metallurgical activities. Another important zinc smelter, the Société des Mines et Fonderies de la Vielle Montagne, is also of Belgian origin ; a measure of co-operation exists with Cie. Royal Asturienne des Mines finding expression in the latter providing some zinc blende roasting facilities on a toll basis.

By-product acid is also a feature of the activities at the lead smelter of Soc. Penarroya at Noyelles-Godault. Here the relatively small output, estimated at 10,000 tons per annum, is supplemented by a brimstone burner.

Recovered Sulphur

Société Nationale des Pétroles d'Aquitaine. The discovery of the large natural gas field of Lacq in December, 1951, lying beneath a small oil field found two years earlier, manifested itself in a major eruption necessitating the intervention of the renowned Myron Kinley to contain it. Even then this potential source of energy and chemicals remained an unrealisable asset until Les Acieries de Pompey, under the able guidance of M. Hertzog, provided the means in the form of steel tubing which withstood the destructive force of corrosion, hydrogen embrittlement and temperature of the sour gas which rose from a depth of nearly 12,000 feet at a temperature of 150°C and pressure of 650 kg/cm$_2$. In April, 1957, the first unit of the sour gas treatment and desulphurisation plant came on stream and was capable of treating a one million cubic metres per day of crude gas. After desulphurisation by diethanolamine and removal of liquid petroleum gases the gas is almost pure methane carrying only about 2% ethane and

2% propane, no H_2S and only 5 to 10 mg. per cubic metre of organic sulphur.

During this year the second phase of the development project has taken shape and having entered operation in two stages the plant is now capable of treating an additional four million cubic metres of gas. By the end of next year this will have risen to 10 million cubic metres and by early 1961 20 million cubic metres. In terms of sulphur the following is believed to represent the probable coming on stream of the respective units :—

Date of Operation	*Million cu. metres gas per day*	*Tons Brimstone per annum*
3rd Phase		
May/June '59	6	420,000
Sept. '59	10	700,000
4th Phase		
March '60	13.5	915,000
Nov. '60	15	1,050,000
End '60	20	1,400,000

Whereas the first unit was basing its desulphurisation process wholly on DEA, the second employs a water washing process which, developed in conjunction with the Soc. Chimique de la Grande Paroisse, is applied to the crude gas to remove about one-half of the H_2S and much of the CO_2. The rest of the H_2S and CO_2 is removed with monoethanolamine. The greater power requirements compared with processing exclusively by DEA are more than compensated by the relatively smaller steam requirements for regenerating the amine solutions. Final traces of sulphur are removed in a caustic soda wash whilst the acid gas containing 65% H_2S and 34% CO_2 is treated in a Claus kiln. Liquid sulphur, with the exception of negligible quantities supplied in liquid state, is solidified in vats on the plant site.

In 1957 Société Nationale des Pétroles d'Aquitaine produced 27,530 metric tons of brimstone of 99.96% purity, representing a yield of 168 tons sulphur per million cubic metres of crude gas. In the first six months of 1958 brimstone output totalled 37,830 metric tons, a yield of about 200 tons per million cubic metre gas. The plant under construction by Foster Wheeler Française and Parsons et Heurtey representing Ralph M. Parsons of Los Angeles is progressing ahead of schedule and its progress is accompanied by the emergence of administration buildings, workers and executives houses and townships, and above all the rapid growth of a gas network together with a start on the construction of factories who will be direct gas users. These include a power station to serve the major aluminium plant to be built by Cie Pechiney and a variety of petrochemicals and fertilizer works under the aegis of Société des Produits Chimique d'Aquitaine which is jointly owned by some of the leading French chemical companies. The key to the rapid progress of construction and, of course, the key to the future arising of brimstone is the rate at which gas is carried and sold. The special position of south-west France as a region of backward industrial development is recognised and the Société Nationale de Gaz de Sud-West, the joint subsidiary of Société Nationale des Pétroles D'Aquitaine (35%), R.A.P. (35%) and Gaz de France (30%), is entrusted with gas distribution which is to be boosted by the special price of 6Frs. per cubic metres, compared with 7Frs. per cubic metre elsewhere. The long-distance pipelines are being built by Gaz de France* and already they are approaching Nantes and

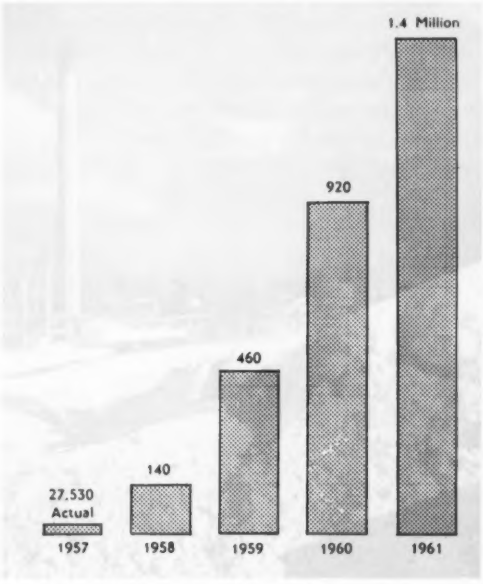
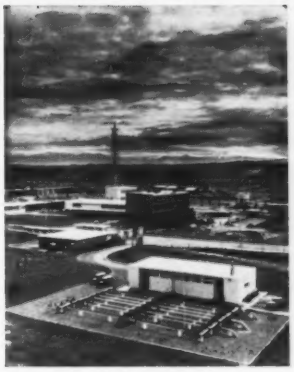


Fig. 2. Estimated sulphur production at Lacq.

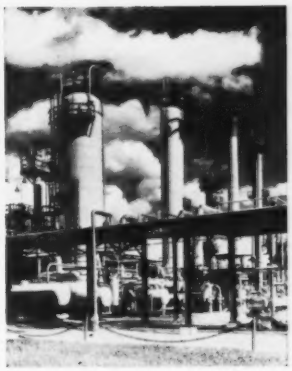
industrial regions of the Massif Central near Montluçon and Clermont Ferrand. By next year it is expected to reach Lyons and environs and Dole in eastern France, whilst Paris is likely to be co-ordinated in the final phase of the present programme.

* Gas transportation and selling through Cie. Française du Methane, a joint subsidiary of S.N.P.A. (50%) and Gaz de France (50%).

Sulphur recovery plant



Gas metering station and administration buildings



Gas cleaning installations

The reserves of the Lacq gas field are conservatively estimated at 150 milliard cubic metres (n.t.p.), representing a working life of 25-30 years at envisaged peak output levels of 20 million cubic metres daily. Exploratory results are awaited to indicate whether an extension of this field towards the west is proved which may enhance reserves appreciably. At this early stage there is, side by side with solid achievement as seen at the rapidly-growing treatment plant, a constant search for better and cheaper methods of gas raising, treatment and despatch such as new steel pipes being tested and new treatment processes for sulphur and liquid petroleum gases being perfected. Brimstone is at present shipped by rail to most customers in France. The small volume of ocean shipment via Bayonne is soon to grow into large quantities. Suitable for 5,000-ton vessels now, dredging of the bar is expected to make the port suitable for 9,000-ton vessels. Loading installations are capable of an hourly rate of 1,000 tons. In conjunction with the port authorities Société Nationale des Pétroles d'Aquitaine is preparing in the port area storage space for up to 40,000 tons, which will be brought in either dry and crushed or liquid form; the main storage facilities being located at Lacq.

Oil Refineries. Sulphur recovery at all refineries has started growing recently but at present only three companies are known to be so engaged. At Berre d'Etang the Cie Shell Française is recovering about 3,000 tons per annum high purity brimstone, Antar des Pétroles is believed to produce a similar amount, whilst Nobel-Bozel S.A. is converting H_2S received from Esso Standard and Socony refineries to brimstone for use in sulphuric acid manufacture at its Petit-Quevilly works. The Frontignan refinery of the Mobil Oil Co. supplies, by pipeline, the adjacent sulphuric acid plant of St. Gobain Balaruc with H_2S for direct conversion to acid. Expansion of refinery activity, boosted by developments in the Sahara and the projected construction of the oil pipeline from Marseilles to Strasbourg, can be expected to raise sulphur recovery from this source to 50,000 tons by 1961 and probably half as much again by 1965.

TRADE

Traditionally France has been one of the major sulphur markets of the world. Prior to World War II the annual level of trade exceeded one million tons of sulphur in various forms; in addition to her domestic needs of pyrites and brimstone France was engaged in substantial entrepôt trade for brimstone from the United States and from Italy, of which a part was processed or refined at the great sulphur refineries at Marseilles prior to re-shipment.

Practically all European pyrites producers engaged in exports have at one time shipped to France. Spain has traditionally held a prominent place in the French market and there are strong ties between some French pyrite consumers and Spanish producers. Soc. Française des Pyrites de Huelva remains the only French-owned pyrites producer in the Huelva district where, up to 1948, Cie. de St. Gobain operated two mines for her own account.

As the result of the break in diplomatic and trade relations following the outbreak of the Spanish Civil War in 1937, hardly any Spanish pyrites entered France for over ten years, leaving a clear field to Portuguese and Cypriot pyrites producers, whose subsequent rapid expansion may be said to have been founded on the opportunity of supplying the large French market. During the past ten years Spain has regained some of the market and to-day may be said once more to have a relatively strong position as a pyrites supplier, especially as balanced bi-lateral trade between the two countries depends to a large extent on French ability to purchase enough Spanish commodities.

PYRITES IMPORTS

('000 Metric Tons)

	Spain	Portugal	Norway	Cyprus	Others	Total
1928	583	104	50	—	88	825
1938	1	287	17	—	125	430
1948	83	319	25	—	177	604
1950	107	198	—	242	—	557
1951	140	240	13	272	—	705
1952	225	190	21	189	—	639
1953	98	88	12	132	—	330
1954	215	138	30	174	—	563
1955	168	171	28	181	7	555
1956	166	116	13	202	—	497
1957			no data			443

In respect of brimstone France stood for many years at the focal point of competition between United States Frasch and Italian native sulphur. The advantage of the short sea journey from Italy, and probably more significantly the shipment in small vessels of under 2,000 tons, ensured a market for Italian sulphur even at a time when in recent years competition from new supplies of Mexican Frasch sulphur had sharpened competition. The adjustment was assisted by the growing requirements occasioned by greater brimstone acid manufacture and by 1957 the following picture had emerged :—

SULPHUR IMPORTS

('000 Metric Tons)

		U.S.	Italy	Chile	Others	Total
1928	...	62	30	—	4	96
1938	...	117	52	7	10	186
1948	...	62	58	—	1	121
1950	...	114	28	—	4	146
1951	...	66	54	—	2	122
1952	...	66	41	—	11	118
1953	...	75	—	2	26	103
1954	...	173	—	16	27	216
1955	...	163	10	33	21	227
1956	...	130	48	3	90*	277
1957			no data			304

* Includes 18 from Mexico in 1955 and 58 from Mexico in 1957.

The growing volume of indigenous supplies in the form of recovered sulphur from Lacq and from oil refineries, apart from its impact on the present import pattern of brimstone and pyrites, is establishing France as one of the major sulphur exporters. This year French exports, representing little more than token or trial shipments to the United Kingdom and various Western European and Mediterranean markets, are expected to total 40,000 tons, whereas in 1959 the export rate is to advance to one-quarter million tons.

In 1961 when the present programme of expansion is to culminate in a production of 1.4 million tons, export markets for one million tons will be sought by France.

CONSUMPTION

Current requirements of sulphur in all forms is estimated at 760,000 tons per annum, representing an advance of 3% over the peak consumption level in 1957. This expansion of sulphur usage, which runs counter to developments in most major sulphur using countries, is based principally on the general growth of industrial activity which, compared with other countries, started much later in France. Except for some pyrites used in the pulp industry and some native ore, non-acid uses, now at 160,000 tons per annum, are wholly based on brimstone. In sulphuric acid manufacture where pyrites predominated, the emphasis is shifting to the use of brimstone and any changes which occurred to date would probably have taken place whether or not French industry could expect to receive brimstone from domestic sources.

At present the French sulphuric acid industry consumes 600,000 tons of sulphur of which 61% is in the form of pyrites, 18% in smelter gases, spent oxide and H_2S, and the balance as brimstone. The trend for the coming five years clearly indicates a substantial increase of brimstone use; the rate, however, is not easily predictable. Pyrites use is entrenched in certain sectors of the industry, notably the smaller superphosphate makers. Special considerations attach to the level of pyrites use of Cie de St. Gobain and Ets. Kuhlmann, the former because of the company's own pyrites production and the latter because up-to-date plant and disposal facilities for residues favour pyrites, notably the high-grade Cypriot concentrates.

The pyrites import requirements of the French sulphuric acid industry are administered by Societe Commerciale de l'Acide Sulfurique, the council of which represents the industry. Bulk purchasing and shipping offers, especially to the large number of small users, the advantages of choice of supply, flexibility and economies of favourable chartering.

Non-Acid Sulphur

This sector of the French sulphur industry was established in 1852 when France's vineyards were threatened with destruction by oidium against which only sulphur—in sublimed form and as flowers—proved successful. Other early uses of sulphur were as disinfectant whereas more recently consumption expanded as the result of extensive usage in rubber vulcanisation, for carbon disulphide in rayon manufacture, sulphur dioxide in pulp mills and the miscellany of modern usage in dyes,

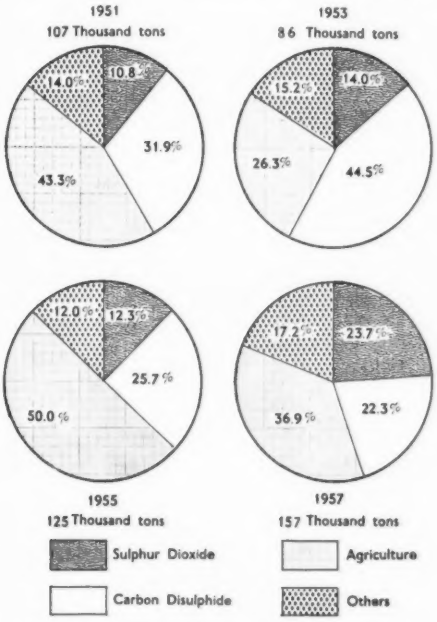


Fig. 3. Consumption of non-acid brimstone.

pharmaceuticals, fine chemicals, match manufacture, sugar refining, bleaching, etc. Over the past ten years consumption of ground and refined sulphur by viticulture has fluctuated between 66,000 and 107,000 tons, other industrial non-acid users have taken 6,500-10,000 tons and 4,000-5,000 tons were exported. Crude sulphur consumption for carbon disulphide and sulphur dioxide ranged from 30,000-35,000 tons per annum, whereas sulphur used for SO_2 has leapt from about 12,000 tons in the early 1950's to 32,000 tons in 1956 and 37,000 tons in 1957.

As the result of the widespread use of non-acid sulphur by French agriculture and viticulture there is a substantial number of small to medium-sized grinders, but the principal load of this sector is carried by six refiners. All grinders and refiners—except the Soc. Languedocienne de Recherches Minières, who since abandoning native sulphur ore refining has been grinding imported material—are organised in the Syndicat de la Raffinerie de Soufre Française which, established in 1895, represents the interests of the industry.

Les Raffineries de Soufre Réunies. The largest and most important sulphur refiner in France, this company, not including the activities of its associates, accounts for 60%-65% of the entire ground and refined sulphur market. Founded in 1898, the company absorbed in 1936 the subsidiaries in France and Algeria of the Union Sulphur Company of New York, which had been formed in the early days of the United States Frasch sulphur industry to provide a European outlet. At present there are four works in France which also assumed the functions of the Sète and the Bassens Bellerive works, both destroyed in World War II.

Marseilles — producing refined, ground and insoluble sulphur

Frontignan (Hérault) — producing refined, ground and micromised sulphur

Bassens (Gironde) — producing refined and ground sulphur

Narbonne (Aude) — producing ground sulphur

and three works—all refineries—in Algeria: Arzew (Oran), Gue de Constantine (Algiers) and Beni-Mered (Algiers).

The other French refiners are:—

La Société Continentale des Raffineries de Soufre with works at Marseilles, La Nouvelle (Aude) and Sète (Hérault).

La Société Marty et Parazols with works at La Nouvelle and at Sète.

La Compagnie Européene de Traitement des Minerais with works at Bordeaux.

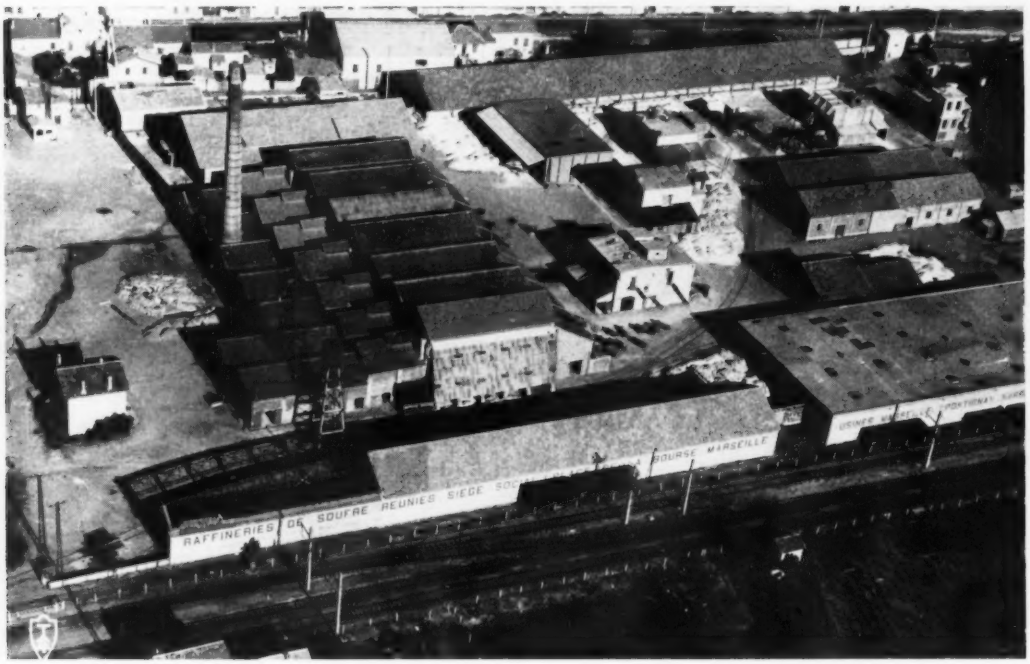
La Société Procida with works near Marseilles and Ets. Kuhlmann with a refinery at l'Estaque.

La Société Vidal et Niel with works at Puisserguier (Hérault).

All the grinders are situated in the Languedoc, in the vineyards and near the ports of La Nouvelle and Sète, through which pass the imports of crude sulphur. The range and quality of the various sulphur products, as well as the standard of plant and equipment, are exceptionally high. Modern furnaces and sublimation chambers, comprehensive mechanisation and continuous distillation processes provide the high purity sublimed sulphur which the wine-growers demand in preference to ground sulphur to combat Oidium. In ever-growing demand by this industry are the very fine sulphur flowers containing a large proportion of insoluble sulphur; Les Raffineries du Soufre Réunies supply this product, under the trade name "Fluidosoufre," and in view of its exceptional lightness and uniformity it appears to be displacing many other forms of sublimed sulphur.

The old grinding installations have now been entirely replaced by modern high capacity grinders operating in inert atmosphere and capable of producing a wide range of grain size from 100 to 300 mesh as wettable sulphurs. In addition micronising mills provide dusting sulphur of even greater fineness. To meet modern agricultural needs sulphur dusts are mixed at the grinding stage with fungicides, such as copper and synthetics, and with insecticides.

Refined products used by the industry are mainly in the form of candles, especially for SO_2 for sugar refining and bisulphites production. In addition to these products Les Raffineries de Soufre Réunies also produce rubber sulphurs, ground from 120 to 300 mesh sometimes impregnated with petroleum compounds, and also insoluble sulphurs of which "MU" is internationally known. Manufacture of this grade entails separation of soluble sulphur, which represents 70% of sublimed sulphur, from the balance of insoluble sulphur, to provide a product containing 95% MU; lately production facilities had to be trebled.



Les Raffineries de Soufre Reunies. General view of the refining plant at Frontignan (Hérault).

Carbon Disulphide. Installed capacity which is distributed amongst six producers is about 45,000 tons CS_2 per annum. Progil of Lyons are the largest single producer with installed capacity of 18,000 tons and output of

12,000-15,000 tons per annum. Ets. Kuhlmann, in accordance with the company's policy of diversification into organic chemicals, have expanded CS_2 manufacturing facilities and now operate installations at the Estaque and Wattrelos works which are capable of turning out 2,500 tons per annum and 6,000 tons per annum CS_2 respectively. Cie Industrielle et Commerciale de Bouchain, a subsidiary of the important Belgian Pont Brulé group, produces 5,000 tons per annum CS_2; Les Filés de Calais meet part of their own requirements from a 4,000 tons per annum CS_2 plant, and Deiss, the old-established chemicals manufacturer of Paris, have a 3,500 tons per annum plant. There is no indication of immediate further expansion in the manufacture of carbon disulphide.

Viscose rayon production, the fourth largest in Europe, is in the hands of nine companies, of whom four produce both filament and staple, the others filament only. Etablissement Kuhlmann, Givet-Izieux, Les Filés de Calais and Viscose Française are the leading producers.

Pulp. Of the four producers, Soc. Landaise Cellulose, La Cellulose de Strasbourg, Soc. Calaisienne de Pâte à Papier and Soc. de Papeterie Navarre, only the last named still uses pyrites in SO_2 production.

Sulphuric Acid

In 1957 production totalled 1.6 million tons (100% H_2SO_4), the highest annual output on record, which according to the first half-year's results should, however, be exceeded by about 3-4% this year. The results of the French sulphuric acid industry in 1957 and in 1956 represent a rate of expansion of 4% per annum, whereas in the preceding two years the growth factor was 8% and 7% respectively. Even so the 1957 level of operation is only 15% higher than output in 1928 and 33% higher than in 1939. The war-time recession, bringing the industry almost to a standstill, severely handicapped post-war recovery which, but for the high production of 1.45 million tons in 1951, cannot be said to have gathered momentum until 1954. In recent years the character of the industry has been gradually changing as greater emphasis on modernisation caused production to be increasingly concentrated into larger units. There is, nevertheless, still a large number of superphosphate manufactures where integrated works include small pyrites acid plants. The requirements of this sector of the fertilizer industry also find expression in the continued employment of a large volume of chamber plant. There is, it is believed, only one tower installation in the whole of France, a Petersen plant, of Cie. Royale Asturienne des Mines at Tonnay-Charente ; in the near future another may be installed at the company's works at Auby. In 1957 chamber acid output of nearly 800,000 tons per annum was the second highest in Europe.

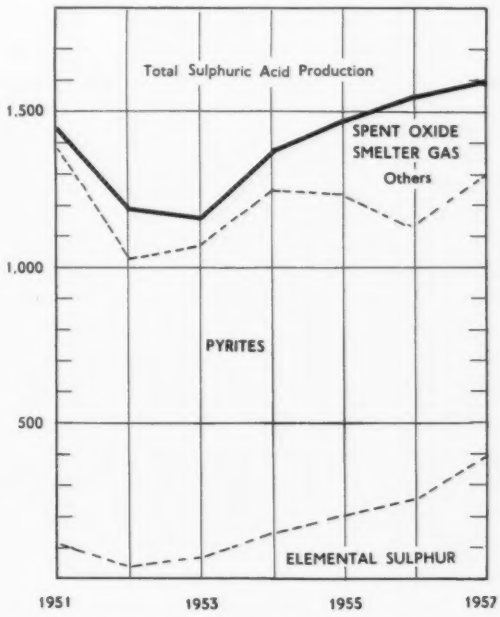


Fig. 4. Total sulphuric acid production.

Coupled with this feature of the French sulphuric acid industry is the substantial volume of plant based on pyrites of domestic and foreign origin. The use of brimstone in sulphuric acid manufacture is by and large a post-war feature which only gathered momentum with the easing of world supplies after 1953. It is estimated that in 1957 21% of total output was based on brimstone. Gypsum acid played a fitful part since the establishment of the small Miramas plant in 1937 until it closed in 1956. Its peak output is believed to have been 25,000 tons per annum in 1939, but not at any time did its economics compare with the rest of the French industry. As indicated above the use of zinc and to a lesser extent lead smelter gases plays a major

part in the French sulphuric acid scene. Present capacity of about 190,000 tons per annum (100% H_2SO_4) is expected to increase if plant improvements especially by C.R.A.M. take effect. A new feature of the industry is the use of H_2S extracted from oil refinery gases in the direct manufacture of acid at the Balaruc plant of St. Gobain. The recovery of H_2S from coke oven gases and the use of spent oxide accounts for little more than 40,000 tons per annum acid. The latest development in this field is the new 15 tons per day Lurgi wet contact acid plant installed by Progil to utilise H_2S recovered from carbon disulphide production.

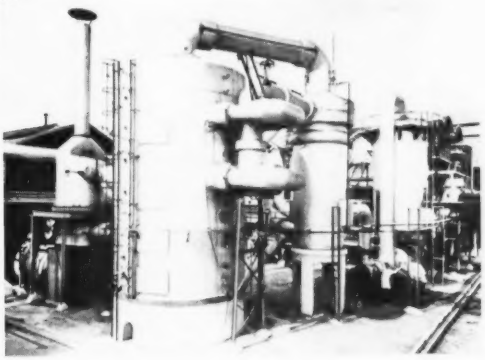
An important feature of the French sulphuric acid industry is the dominant position of two major producers, Cie. de St. Gobain and Ets. Kuhlmann whose output, originating from a substantial number of plants, accounts for 36% and 24% of total French production respectively. Only three other producers, Cie. Bordelaise, Cie. Royale Asturienne des Mines and Union Française, all operating more than one plant, manufacture in excess of about 50,0000 tons annually, although Bozel-Maletra, as the result of their new joint enterprise Nobel-Bozel can be expected to come into this range this year. About eight producers operate at between 10,000 tons and 50,000 tons per annum and fifteen at less than 10,000 tons per annum.

Ste. des Manufacture des Glaces et Produits Chimique de St. Gobain, Chauny et Cirey. Notwithstanding the company's world wide fame as a glass manufacturer, her chemicals activity accounts for nearly three-quarters of the annual gross turnover. The second largest enterprise in the chemicals industry of France, sulphuric acid manufacture, has from early days played a major part in the company's activities, which being vertically organised, resulted in it becoming the largest superphosphate maker in France and in 1920 86% of French production of 1.8 million tons originated from St. Gobain works. Currently Cie de St. Gobain produces about 40% of French superphosphate output of 1.15 million tons and also provides a large proportion of mixed fertilizers. Association with Cie de la Grande Paroisse provides a close link with a leading ammonia producer and an important participation has been established in the new chemical combine Soc. des Produits Chimiques d'Aquitaine, whose activities are based on the Lacq gas. Modernisation and rationalisation of sulphuric acid production has been speeded up in recent years and at present the company's output is believed to originate from some 10 plants. Four plants, including those at Tonnay-Charente and Le Boucau having been closed recently, whilst the two plants at Nantes have been transferred to and are now operated by the Soc. des Fertilisantes de l'Ouest, a joint subsidiary with Cie. Dior. The larger installations include the plants at Chauny—the company's largest, with an annual capacity of 120,000 tons—Aubervilliers, Grand Quevilly, Rouen and Wasquehal. A recently installed brimstone acid plant at Le Havre supplies the needs of Les Produits du Titane, a new TiO_2 pigments producer*. St. Fons, France's most modern pyrites acid plant, commissioned last spring, is expected to provide acid economically on the basis of the company's own pyrites resources and meet the needs of the dye and textile industry in Eastern France. At present the company's sulphur needs are estimated at about 200,000 tons per annum of which 70% is met in the form of domestic and imported pyrites and 30% in the form of brimstone.

Etablissements Kuhlmann. This company is the largest manufacturer of chemicals in France with predominant interests in the French dye stuff industry, and most recently in the treatment of indigenous uranium ores. Increasingly emphasis is being diverted from inorganic to organic chemicals; nevertheless mineral acids, especially sulphuric acid, alkalis and fertilizers are amongst the company's key products. The company has widespread participation in a variety of chemical works which include manufacture of by-product and synthetic ammonia, potash, industrial phosphates and phosphoric acid. Sulphuric acid is produced at about one dozen plants. Recent changes from pyrites to brimstone use as at Dieuze and l'Estaque, and greater use at Paimboeuf and La Madelaine, has raised the proportion of brimstone acid to about 40% of Kuhlmann's total output of close on 400,000 tons per annum (100% H_2SO_4). The use of spent oxide and zinc blende represents about 20% of the total, whilst pyrites—wholly imported—is estimated to represent 40%.

* See No. 18 — P. 39.

Pyrites acid plants are situated at the major ports such as Rouen, Bordeaux and Nantes and in the northern industrial region where the Kuhlmann activities are focussed. Noteworthy are the works at Loos, the first of the Kuhlmann factories and established in 1825, Harnes and Chocques which have important ammonia installations. The company also operates the only fluidised bed roaster and the only two flashroasters in France.



Ets. Kuhlmann convertor section of the Loos sulphuric acid plant.

Uranium ore leaching is carried out by Soc. Industrielle des Minerais de l'Ouest (S.I.M.O.) which started operations in the spring of last year and now operate two plants, one in the Vendée and the other at Limousin.

Other Manufacturers. Union Française operates five superphosphate plants all situated in the centre of the agricultural regions. The company owes its origin to the need of Cie. des Phosphate de Constantine to establish an outlet for phosphate rock in Metropolitan France.

Soc. Finalens is expected to convert to brimstone its acid making facilities which in the past provided a regular outlet in France for Norwegian pyrites. Amongst the smaller acid/fertilizer makers similar action is being taken next year by Soc. Agricola and probably also by Ets. Hurel. The sulphuric acid output of Cie. de Thann & Mulhouse at Strasbourg is based partly on brimstone, partly on indigenous pyrites, and is used mostly in titanium pigment manufacture in which the company holds a prominent and established position.

Consumption of Sulphuric Acid

In 1957 total consumption amounted to 1,634,000 tons, an increase of 4¼% over the preceding year. In addition to virgin acid some 33,000 tons of spent acid was consumed. Fertilizers account for 50% of total usage, compared with 56% in 1950 and 64% in 1938. Superphosphate and phosphoric acid manufacture, which at present account for 660,000 tons sulphuric acid, increased its acid needs in the past eight years by 30%. Ammonium sulphate however, apart from a 10% upward fluctuation in intervening years, was the same in 1957 as it had been in 1950, principally because ammonium nitrate—also a 20% N fertilizer—became over 15% cheaper some years ago and its price even to-day is 5% less. Cheap sulphuric acid could reverse this trend. Acid use for man-made fibres has expanded 42% to 142,000 tons between 1950 and 1957. Titanium dioxide has not yet assumed the leading role in acid usage which it holds in the United States, United Kingdom and Germany and together with lithopone represents only 46,000 tons acid or less than 3% of total usage. More important, with an annual consumption level of close on 100,000 tons, are the iron and steel industry and a group comprising makers of dyes, pharmaceuticals, organic chemicals and petrochemicals.

Thousand Metric Tons 100% H_2SO_4	*1950*	*1953*	*1955*	*1957*
Superphosphate ...	481	435	563	599
Ammonium Sulphate	206	193	220	207
Artificial Textiles ...	98	108	129	142
Dyestuffs, Sulphonates	43	66	94	102
Metallurgy	73	74	83	84
Phosphorus	25	25	44	60
Potassium Sulphate	21	29	39	42
Titanium Dioxide ...	—	—	41	46
Sodium Sulphate & Hydrochloric Acid	33	33	37	39
Aluminium Sulphate	17	24	28	34
Explosives	7	40	46	26
Petroleum Refining...	20	33	23	26
Others	211	190	172	207
Total	1,235	1,250	1,519	1,634

CONCLUSION

The successful implementation by Société Nationale des Pétroles d'Aquitaine of the first two phases of the development plan for the natural sour gas field at Lacq, leaves no doubt that in three years' time France will dispose of 1.4 million tons per annum high purity brimstone. Her ability to market it competitively is vested in the economics of the essential

cleansing process of this new priority source of energy supply of which sulphur is a by-product. Although the greater part of deliveries will be directed to the European markets, which is at present the largest sulphur importing area, France will in effect become a world exporter. Geographical factors, represented by the influence of the cost of transport on net revenue will determine the destination of her shipments although in this respect the desire for flexibility on the part of consumers can be expected to militate against monopoly in any market.

The domestic market, whilst potentially the largest single outlet, is nevertheless typical. The influence of the prodigious new source of high purity brimstone supply is evident in the development of all sectors of the French sulphur industry. Not unexpectedly, however, the approach to this new feature by individual users and user groups has been cautious and governed throughout by purely economic considerations. The advantages which an indigenous source of cheap sulphur can confer on an industry, which only recently has emerged from a period of near-stagnation, are recognised and whilst short-term plans for expanding brimstone use are slow, the longer term implications could be revolutionary. Inevitably under the influence of the advantages of proximity, security of supply and ability to compete in terms of quality and price the greater part of non-indigenous brimstone supplies will be displaced, whilst the scope of pyrites usage will be further circumscribed. French domestic brimstone demand at present 280,000 tons is expected to rise to 400,000 tons by 1961, mainly due to expansion of overall sulphur use. The outstanding impact of Lacq sulphur on the world sulphur industry is, however, likely to occur when the manufacture and sale of sulphur based end-products, notably fertilizers, is boosted by the stimulus of abundant cheap brimstone supply. If the French chemical industry is ready to take advantage of these favourable conditions, her growth of stature within the framework of the progressively closer trade ties in Europe is assured.

Sulphur Developments in Cuba

DURING THE post-war years the Cuban economy has made very considerable progress and to-day for its size, it is probably one of the most highly developed in Latin America. The year 1957 marked the highest level of economic activity since the war, and according to preliminary estimates Gross National Product at current prices has risen by more than 11% compared with the preceding year, when the economy had already recovered from the 1953-5 recession. However, economic progress is still largely based on the sugar industry, both as an employer of labour and an earner of foreign currency for further development. Apart from the obvious weakness of a "Single Commodity" economy, its seasonal character leads at certain times of the year to unemployment of as much as 500,000 or 8% of the total population. This position is fully appreciated by the Cuban Government which, despite political difficulties, is pursuing a policy of diversification which has already borne fruit. In practice the programme is designed to promote the development of those industries which will provide greater flexibility in the Country's export trade, and to encourage foreign investment, particularly in oil, mining and chemical industries. Diversification of the manufacturing industry should provide greater economic and employment stability and reduce the country's dependence on imports. In all these fields production and consumption of sulphuric acid assumes an important place, particularly as the number of integrated projects is growing.

Sulphuric Acid

Production of sulphuric acid in Cuba is at present restricted to three companies whose total capacity represents 49,000 short tons per annum (100% H_2SO_4) in the form of various grades including oleum. All three plants operate on brimstone imported mainly from the United States and occasionally from Mexico and which in 1957 amounted to 19,000 long tons.

Prior to 1942 Cuba's limited requirements of sulphuric acid were met by imports, but in that year Electro Quimica del Caribe, S.A., brought on stream a 12 tons per day (100% H_2SO_4) plant at Sagua La Grande, the output being used captively in the production of

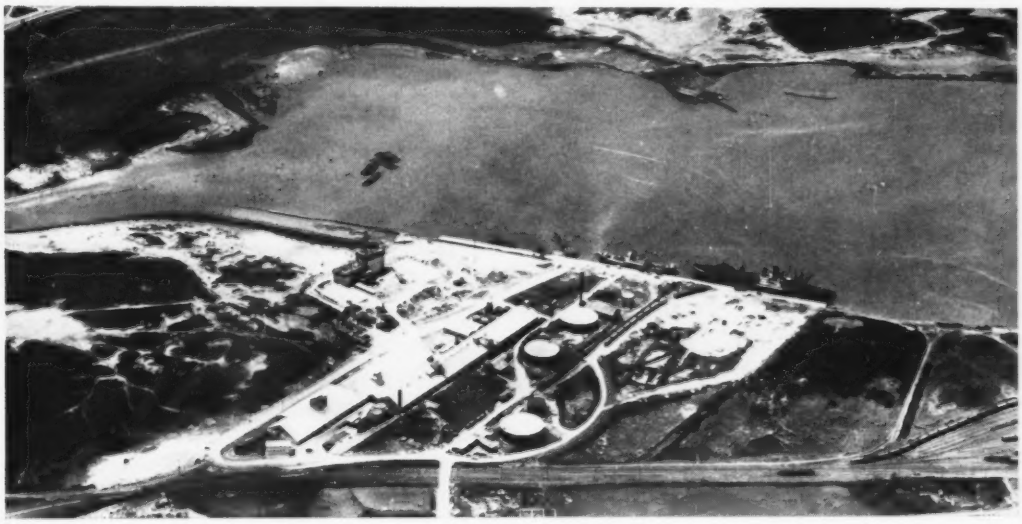
various chemical products. In 1948 the Compania Quimica Commercial de Cuba, S.A., which is now part of the Industrias Consolidados de Matanza, S.A., established a 40 short tons per day (100% H_2SO_4) acid plant at Matanzas, 65 miles East of Havana. By 1955 two expansions had increased the size of the plant to 75 short tons per day (100% H_2SO_4) with facilities for 15 tons of oleum. Most of the output of 98% acid is supplied to the neighbouring viscose rayon plant of Compania Rayonera Cubana, S.A., whilst acid in excess of the rayon plant's requirements finds a market in the distillery industry, producing industrial alcohol from molasses, and in tanneries. Oleum is supplied to two American companies in Havana producing synthetic detergents. Due to the extension of the viscose rayon plant's capacity plans are now under way to increase the capacity of the sulphuric acid plant to 100 tons per day (100% H_2SO_4).

The third Cuban acid plant is operated by the Country's sole manufacturer of superphosphate, Productora de Superfosfatos, S.A. This plant, which was built by the Chemical Construction Corporation of New York in 1948, has a capacity of 65 tons per day (100% H_2SO_4), including facilities for producing 10 tons per day of oleum. Approximately 90-95% of output is used captively in the production of superphosphate, whilst the remainder is sold as oleum or weaker sulphuric acid for miscellaneous uses.

All three of these existing acid plants have been working close to full capacity for some time and although one extension is already being carried out it is evident that additional acid capacity will be required for further industrialisation. This applies especially in the case of Cuba's rapidly developing mineral industry and it is probably here that large integrated projects can contribute most to the economy.

Sulphur in Nickel Production

Outstanding among projected developments is the Moa Bay project of Cuban American Nickel, a subsidiary of the Freeport Sulphur Company. This scheme, estimated to cost $119 million, is basically for the production of nickel and cobalt concentrates. Essential features of the plant, which will produce 50 million lbs. of nickel and 4.4 million lbs. of cobalt, will be the world's largest sulphuric acid plant with a daily capacity of 1,400 tons (100% H_2SO_4) and a hydrogen sulphide plant which will have a daily capacity of 60 tons H_2S. Sulphur, for sulphuric acid and H_2S production, will be shipped in molten form



Productora de Superfosfatos S.A. Aerial view of superphosphate production and storage facilities, at Matanzas. Sulphuric acid plant located at far end of storage shed.

from Freeport's facilities at Port Sulphur, Louisiana, and at the same time methane for the production of hydrogen will be brought in. Nickel ore refining is to be based entirely on chemical processing. The ore slurry is fed to a battery of autoclaves, where it is mixed with sulphuric acid. Substantially all of the nickel and cobalt in the incoming ore slurry is put into solution in the autoclaves, which operate under elevated pressures and temperatures. After thickening and washing, the acidity of the solutions is adjusted and a precipitate or concentrate of nickel-cobalt sulphide is obtained by the addition of hydrogen sulphide. The concentrate, containing about 55% nickel and 5% cobalt is then transported in a special vessel to Port Nickel, Louisiana, for final processing.

The Moa Bay development is the first integrated project of this type in Cuba. Apart from its importance to the Cuban economy, it is also of great significance in the future pattern of United States sulphur exports. In 1957 only two other countries, Canada and Great Britain, imported more than 160,000 tons from the U.S.A., whereas this tonnage will probably be exceeded by Cuba in 1960. Coming at a time when the Freeport Sulphur Company's new domes are nearing the production stage this new outlet will be of great value to the parent company. Moreover, the satisfactory chemical processing of lateritic nickel ores, which represent the bulk of unexploited major nickel deposits in the world, by means of sulphuric acid, holds out prospects of a new major use for sulphur.

Non-Acid Sulphur

Consumption of non-acid sulphur is at present restricted to the small production of carbon-disulphide (15 tons per day) by Compania de Fomento Quimico, S.A., of the Matanzas Group and the projected manufacture of H_2S by Cuban-American Nickel at Moa Bay. Three United States rubber companies have announced their intention to establish tyre plants in Cuba although it is not yet stated whether they will employ natural or synthetic material.

Pyrites

Among Cuba's other mining interests is the production of pyrites, mainly by the Compania Minera Cortesa, S.A. These pyrites, which contain 48% sulphur, 1% copper and the remainder iron, gold and other minerals, have in the past found a market in Europe, particularly Italy, Germany and Belgium. Exports have in recent years reached approximately 120,000 tons annually, but in common with difficulties experienced by other pyrites producers, the Cubans have during the past 18 months found the market for their output becoming increasingly competitive. It is, therefore, interesting that in December last year it was announced that the Compania Operadora Rometales, S.A., had been granted a $7.4 million loan by the Economic and Social Development Bank for the construction of a pyrites processing plant for the recovery of copper, lead, gold and silver from the pyrites. Included in the plant will be a sulphuric acid unit to be constructed by Krebs & Cie, of Paris, with a daily capacity of 300 tons (100% H_2SO_4). In order to feed the recovery plant it is expected that several pyrites mines located in the province of Pinar del Rio will be reopened. It is not thought that Compania Operadora Rometales will be able to consume the full output of the sulphuric acid plant, and it is hoped that the availability of a source of sulphuric acid supply may encourage the establishment of other acid consumers.

Conclusion

The growth of Cuba's sulphur industry is not so much impressive on account of the rapidity and size of expansion, but rather by emphasising the great potential for development that exists in Latin-American countries. The sudden leap from the modest level of sulphur use of about 11,000 tons per annum to one of some significance on world scale, by virtue of the installation of a single project, is a striking feature which may nevertheless become commonplace and necessary to promote speedier industrialisation of under-developed countries. Cuba's importance to the United States' sulphur industry and to the Freeport Sulphur Company in particular will be enhanced as competition in overseas markets grows. Above all, the success of lateritic nickel ore treatment by means of sulphuric acid would provide a much-needed new outlet for sulphur.

In addition to the dominant sulphuric acid use in metallurgy, the requirement in fertilizers, rayon, chemicals and possibly in uranium extraction, is expected to provide expanding outlets for sulphuric acid production.

Prices and Trends

THE WORLD PRICE of brimstone has undergone no overt change in the past three months. An increasing volume of world sales is, however, being transacted on "delivered" terms which, while ostensibly based on posted f.o.b. prices, often contain disguised discounts within the freight element. In June there were some signs that the world brimstone market was settling down but it soon became apparent that this was a superficial impression, occasioned mainly by the deliberate absence of any significant pressure on overseas markets by the Mexican producers. In the following weeks market sentiment again weakened, partly as the result of low priced offers on delivered terms to several European users by Sulexco and Soc. Nationale des Pétroles d'Aquitaine, but perhaps more on account of an outstanding major contract in the United States for which it was thought that Mexican sulphur might successfully compete. It is significant that this opportunity of securing an important position appears to have deliberately passed up and there are strong reasons to believe that had the Mexican company not done so, prices in the United States and world prices might have plunged at least $2 and probably broken under $20. The ability to exercise this restraint underlines the stature which Mexican Frasch sulphur has acquired in the relatively short period of its operation. It is also evident, especially in the case of the Pan American Sulphur Company, that greater emphasis is now placed on the finer competitive points such as quality of material, delivery and service. The considerable competitive strength and prosperity built up over four years of rapid and world-wide expansion is, according to Mr. Harry C. Webb, President of Pan American Sulphur Company, not to be expressed by aggressive selling.

Suggestions voiced in some circles of an imminent price rise were quickly refuted by the Chairman of Texas Gulf Sulphur Company, Mr. Fred M. Nelson. This responsible action underlines the need to re-establish confidence and stability and to counteract the effect of the adverse statistical position which, for at least five years and possibly even further ahead, shows a state of excess capacity and supply. In the past 12-18 months it has been shown again that owing to the lack of elasticity of the sulphur market price changes have very little effect on the absolute volume of sales and that the entry of any substantial volume of new production has been accompanied by a recession of price. The inducement of lower, or at least parity prices has as a rule secured for the newcomer entry into the market, but efforts by an established producer, to retain by means of price cutting a customer who is prepared to support a new supplier, seem to fail.

An assessment of the current position indicates that until the middle of next year the present price level of brimstone and also of pyrites should remain constant. This breathing space should provide the occasion for stock-taking and proving how best to steer the industry through the coming five years' excess of supply over demand without causing casualties in the ranks of producers whilst retaining the confidence of users.

PRICES

The posted price of *United States Frasch sulphur* in domestic and in export markets is U.S. $25 per ton f.o.b./f.a.s. U.S. Gulf Port for bright material. A discount of $1 per ton applies to deliveries of off-colour sulphur whereas for shipment ex-mine (f.o.r.) the differential remains $1.50 per ton, below the respective standard prices of bright and off-colour sulphur. Intense competition has obscured the accepted pattern. Sulexco, especially in Europe, are now in most instances quoting delivered prices, whilst in the United States the higher freight payable for tariff-bound U.S. vessels compared with the corresponding rates from Mexico under non-United States flags, have prompted some of the producers to grant freight rebates. Current quotations indicate delivered prices of $25 to $27 per ton along the Eastern Seaboard, $27 per ton at N.W. European ports, $31 per ton in South Africa and Eastern Canada.

The producers of *Mexican Frasch sulphur* have continued to base their price on $23.50 per ton f.o.b. Coatzacoalcos for fully-filtered yellow material. Off-colour and unfiltered supplies range down to $20.50 per ton f.o.b. The weak freight market adds to inherent advantage of shipping under flags other than United States. Many of the older contracts

with United States consumers provide for fixed differentials compared with ruling prices of United States Frasch sulphur. Exceptionally cheap spot sales appear to be possible from Tampa and Norfolk stockpiles as the result of the Mexican producers and their United States sales associates—notably International Ore & Fertilizer Corporation—taking advantage of favourable shipping opportunities to replenish stocks.

Owing to their inability to compete at ruling international prices, which in the Mediterranean markets are at least Lire 5,000 per metric ton (about £3) lower than elsewhere, *Italian* exports based on Lire 23,000 per metric ton (£13 7s.) per ton have virtually ceased. A proportion of available subsidies is devoted towards the execution of existing contracts but increasingly the main emphasis is to be placed on subsidising sulphuric acid/fertilizers manufacture based on native sulphur ore.

The sale of *Chinese refined sulphur* to Australia is believed to have been effected at a price equivalent to £10 per ton f.o.b. Tientsin. No further offers in markets East of Suez where this price is competitive have been reported, but there have been enquiries through merchant houses in London and on the Continent.

In *Japan*, despite a further weakening of the domestic markets, the price level of Yen 21,200 established last February remains unaltered.

The price of *recovered sulphur in West European countries* remained fairly steady. The few changes appear to have been occasioned by some lower quotations of United States sulphur which Sulexco attribute to exceptionally low freight rates; they are based mainly on deliveries from the Sulexco stockpile at Hamburg and on cargoes f.o.b. Rotterdam.

prices which, on the Continent, are almost everywhere identical with delivered prices of Sulexco or Mexican Frasch sulphur, and in lowering prices Société Nationale des Pétroles d'Aquitaine re-established, where required, such a parity. The company's policy of obtaining the highest possible price compatible with securing a share of a market remains unchanged.

The domestic price in Western Germany for brimstone recovered from spent oxide by Ruhrgas A.G. and at oil refineries has weakened a little as the result of large offerings from the Sulexco stockpile in Hamburg. Prices of DM 120-125 per metric ton are reported. In Belgium and Holland recovered sulphur is reported on sale at BFrs. 1,500 and DM. 110-115 per metric ton respectively. In Scandinavia, as the result of reduced demand by the pulp industries, the price position appears to have weakened but quotations are at present little affected; in Sweden domestic supplies recovered by Svenska Skifferolje A.B. from oil shales are reported at SKr. 180-200 per metric ton, whilst in Norway brimstone, recovered by Orkla Metal A.S. from the smelting of cupreous pyrites, is reported to be on sale at NKr. 240-250 per metric ton f.o.b.

In Western Canada price of supplies to pulp mills and sulphuric acid plants range up to Cn. $45. Some exports to United States have started moving but other export markets are not as yet being approached. Quotations are reported at Cn. $23.50 f.o.b. Vancouver.

The following table indicates broadly the delivered cost of brimstone of varying origin at principal consumers' destinations based on posted prices and ruling freight rates. The rates shown are either actual charters made at the end of September or reliable indications :—

f.o.b. Country of origin	*U.K.*	*N.W. Europe*	*France (Mediterranean)*		*India*		*Australia*	
U.S.A. $24-25 ...	(43s.) £10¼-11⅛	(37s. 6d.) £10½-10⅞	(45s.)	£10⅞-11¼	(75s.)	£12⅛-12¼	(65s.)	£11⅞-12½
Mexico $20.50-24	(43s.) £9½-10¼	(37s. 6d.) £9⅝-10½	(45s.)	£10-10⅞	(75s.)	£11½-12⅛	(65s.)	£11-11⅞
Italy Lire 23,500*	(25s.) £14⅝	(22s.) £14½	(20s.)	£14⅛	(50s.)	£15⅞	—	—
Canada $23.50 ...	(60s.) £11½	(55s.) £10⅝	(55s.)	£11¼	(70s.)	£12	(60s.)	£11½

Freight indications ( ) have been reduced to f.i.o. terms to provide a common basis for comparison. *Per metric ton.

Sales by Soc. Nationale des Pétroles d'Aquitaine of brimstone recovered from natural gas at Lacq are reported at Ffrs. 12,000-14,000 per metric ton in domestic markets. Now that the volume of production is rising rapidly export sales are increasing at

Pyrites

The price reduction which took effect on 1st July made a favourable impression on the markets and in many locations price parity has been re-established or even a small advantage gained over the comparable cost of brimstone.

The price of Spanish crude pyrites, notably Rio Tinto and Tharsis, during the second half of the year is 77s. 6d. per metric ton f.o.b. Huelva, basis 48% S, whereas Rio Tinto flotation concentrates are exported at 67s. 6d. Comparable prices are quoted by Cyprus Mines Corporation and Portuguese crude pyrites are priced at 72s. 6d. per metric ton f.o.b., basis 48% S. In the markets dependent on pyrites imports it is evident that the reduction of prices has caused decisions concerning conversion to brimstone plants to be deferred. In pyrites producing countries the expansion of demand appears to be exerting an upward pressure on domestic prices; this is evident in Spain and Portugal. In Canada prices remain unchanged at about $2.40 per short ton ex-mine and $3.60-$5.50 f.o.b. Rising copper prices have renewed interest in Turkish and Cuban cupreous pyrites, but in respect of iron values the residues market remains unsettled in anticipation of the widely publicised, but as yet not evident, upturn in iron ore demand and higher prices. Failing this the lack of stability in residues and agglomerate prices would cause sulphur in pyrites to become, once more, less competitive in relation to brimstone.

Freights

The voyage index of the U.K. Chamber of Shipping (1952=100), which in June stood at 66.5, steadied in July and receded slightly by the end of September to 65.7.

The seasonal weakness in movement of basic minerals and ore was evident in the low level of chartering in almost every market. The earlier trend to lay-up ships has slowed down mainly under the influence of over 100 vessels being taken by China on time charter over the past few months. The expectation of a large volume of grain to be shipped from Australia and the indifferent harvest results in Europe have influenced grain rates but have not so far had a significant effect on the general level of freight rates.

From the United States and Mexican sulphur ports in the Gulf of Mexico spot vessels to the United Kingdom are reported at about 47s. 6d. and to the Continent at about 37s. 6d. f.i.o. for liberty vessels; $4 f.i.o. is reported for vessels of about 15,000 tons.

European pyrites freights, in common with phosphate freights from North Africa, have remained unchanged. Rates from Huelva to Antwerp/Rotterdam/Hamburg 8,000-ton vessels are reported at 23s. 6d. and similar sized vessels from Cyprus are paying 25s. 6d. to 27s. The smaller handy-sized vessel remains in demand and from Huelva to United Kingdom up to 37s. has to be paid. Charters for Lacq brimstone to N.W. Europe at 17s. 6d. and West Coast of United Kingdom at 24s. to 29s. depending on the port are useful pointers for this expanding business.

Distant rates are subject to greater fluctuations largely dependent on trading opportunities. United States Gulf ports to Australia at 85s.-90s. is a little firmer, whereas to India (East Coast) freights are charged at 75s. and to South Africa down to $6.50. Rates from China (Tientsin) to East Coast Australia have been quoted at 52s. 6d.

SUPPLY

Brimstone

A combination of seasonal factors and the residual affect of the recession further reduced domestic demand in the *United States* and in consequence monthly Frasch sulphur production rates were cut to about 370,000 tons per month, about 100,000 tons less than one year ago. Stocks of Frasch sulphur have increased but lower oil refinery activity slowed down recovered sulphur production which was approximately equal to demand. Production of Frasch sulphur in *Mexico* remains high and there is every indication that 1958 output will reach 1¼ million tons. Pan American Sulphur Company, employing about 60% of installed water capacity, is producing constantly 2,000-2,200 tons per day. Gulf Sulphur Corporation has successfully resolved production difficulties at Las Salinas and current output generally exceeds 1,000 tons per day. As Texas International Sulphur Company has not yet started production and Texas Gulf Sulphur Company operations at Nopalapa remain restricted, overall stocks of Mexican Frasch sulphur have not advanced significantly and are estimated at about three-quarter million tons. Output of fused sulphur in *Italy* is being cut back and is unlikely to exceed 150,000 tons this year. Stocks are reported to have increased and are estimated to total about 230,000 tons of various grades. Production of elemental sulphur in *China* is reported to be rising. Exports to the U.S.S.R., notably to Eastern Siberia which in 1957 totalled 70,000 tons, are said to be maintained and indicate that overall output may this

year reach as much at 150,000 tons elemental sulphur, mostly refined from native sulphur ores but possibly also resulting from pyrites smelting. In *Poland* the first development stage of the Piaszecno sulphur deposit is reported to be making good progress and this year's anticipated output of 20,000 tons is likely to be achieved. The further plans by which output was to have been raised from 100,000 tons to 300,000 tons per annum by 1963 have been obscured by reports of changes in Czechoslovak and U.S.S.R. technical aid proposals. This may be linked with the intensified exploitation of sulphur ore deposits in the Ukraine. In *Pakistan* exploitation of the Baluchistan sulphur ore deposits is to be resumed. Available stocks have been used up or committed in two ore refining projects which plan to meet the country's domestic needs.

Tharsis Sulphur and Copper Co. New pier installations at Corrales (Huelva). Note tip discharge from hoisted rail wagon.

Recovery

Recovered sulphur output in the United States has faltered mainly as the result of reduced level of operation of the oil refineries. The average daily rate of about 1,600 tons brimstone in the summer months is expected to rise to well over 2,000 tons as industrial activity accelerates in the autumn.

In Canada the level of natural gas operation, and in consequence sulphur recovery, has not altered significantly. There is, however, much progress in the development of new gas cleaning and sulphur recovery plant by Texas Gulf Sulphur Company at Okotoks and Jefferson Lake Sulphur Company near Calgary. On 1st November British American Oil Company is to step up the rate of operations at Pincher Creek to meet its gas supply obligations vis-à-vis Trans-Canada Pipe Line. The imminent publication of the Borden Commission's energy report will clarify the gas export proposals and it is expected that as a result gas supply and cleaning and with it sulphur recovery will expand spectacularly.

Recovery at Lacq by Société Nationale des Pétroles d'Aquitaine during the first six months yielded about 38,000 tons high purity brimstone. At present monthly output is about 15,000 tons and is due to rise to 30,000 tons per month within the next few weeks. Oil refinery operations throughout Europe have continued at fairly even level and output of recovered sulphur has been maintained at about 13,000 tons per month.

Pyrites

The majority of European pyrites producers have reduced output and shipments in recent months. Seasonal factors coupled with widespread over-supply of sulphuric acid have been mainly responsible. Exports of iron and cupreous pyrites from Cyprus totalling 512,000 tons during the first six months of this year were above average. This was partly the result of greater demand from France where the pyrites imports picture is, however, favourable, and partly due to greater shipment to Belgium where overall imports are nevertheless 10% lower on account of lesser imports from Spain. The situation is similar in the Netherlands. In Norway, where pyrites output in 1957 totalled 831,300 metric tons—including 35% pyrites used for smelting—the level of production this year appears to be adversely affected by rising costs and lower pyrites demand. Expansion of pyrites output in the Balkans has not made any notable impact on Western markets apart from increased offers of Jugoslav pyrites concentrates. There are ample supplies of by-product pyrites in Canada to fulfil domestic and export demands. In the United States the labour dispute at the Climax-Molybdenum mine terminated operations in July and customers' needs have had to be met from stocks which proved adequate.

UNITED STATES SULPHUR

Frasch Sulphur

PRODUCTION OF Frasch sulphur during the second quarter of 1958 amounted to 1,201,360 tons compared with 1,305,946 tons in the preceding quarter and 1,330,329 tons in the corresponding period of 1957. Whereas production during the second quarter of 1957 was only 5½% lower than in the first quarter, this year the decline from the first quarter amounted to 8% at a level 10% lower than in 1957. Total production for the first six months of 1958 was 2,507,306 tons compared with 2,737,227 tons during the first half of 1957, a decline of 8½%.

Individual producers continue restricting output in the light of lower domestic sales. The current level of production is estimated to represent about 60% of installed capacity and is 31% below the peak rates of the latter part of 1956.

Texas Gulf Sulphur Company's new Fannett Dome, capable of producing annually 400,000 to 500,000 tons of sulphur, began operations on 16th May. The repeated deferment of the starting date is typical of the industry's self-imposed restraint. In common with other dome developments, leasehold obligations appear to have played a major part in determining the need to start operations. Texas Gulf Sulphur Company's results for the first half of the year compared with the corresponding figures last year show a decline of just over $10 million in gross sales revenue and $4 million in net income. Gross sales revenue rose slightly compared with the first quarter—from $12 million to $14 million—but selling and administration expenses continued to rise and earnings per share at $0.345 were slightly lower than for the previous quarter. Earnings per share for the first six months were $0.692 against $1.097 for the first half of 1957 and $1.473 for the first half of 1956.

The Freeport Sulphur Company finalised the sales of its oil and gas properties which in July were acquired by Magnolia Petroleum Company, an affiliate of Socony Mobil Oil. The purchase price was $100 million, of which a part is to be paid out of future revenue. Whereas Freeport Sulphur Company's strengthened liquid cash position should prove to be of value in connection with the development of the nickel/cobalt project in Cuba and the new off-shore dome developments at Lake Pelto and Grand Isle, the improved range of Magnolia Petroleum Company's oil and gas properties should amongst others enhance its potential as a producer of recovered brimstone in which sector it already plays a part.

Apparent sales of Frasch sulphur in the second quarter amounted to 1,160,658 tons compared with 1,107,000 tons in the previous quarter and 1,470,026 tons in the corresponding period of 1957. The rise over the first quarter was due mainly to seasonal factors and increased exports, but the decline of 21% compared with the second quarter of 1957 is indicative of the difficulties facing the United States Frasch industry. Total apparent sales for the first six months of 1958 were 2,268,205 tons against 2,587,063 tons during the first half of 1957. Thus despite the lower level of production—the June output was only 383,664

tons—stocks continued to rise during the second quarter and at the end of June stood at 4,661,649 tons compared with 4,621,000 tons in March and 4,086,614 tons at the end of the second quarter of 1957.

Recovered Sulphur

During the second quarter of 1958 the expansion in the production of recovered sulphur was halted due to the impact of the recession on the demand for oil and the level activity in the petroleum industry. Production amounted to 143,813 tons compared with 153,957 tons in the previous quarter and 123,917 tons in the second quarter of 1957. It is, however, expected that as industrial activity rises the production of recovered sulphur will resume its growth. At present installed capacity is about one million tons brimstone of which about two-thirds is based on oil refineries and one-third on natural gas.

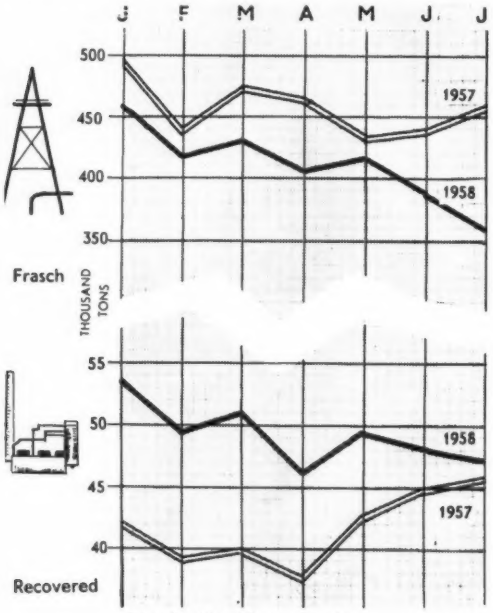


Fig. 5. Monthly production.

Apparent sales amounted to 146,402 tons compared with 147,564 tons during the first quarter and 91,069 tons in the second quarter of 1957. As production fell below the level of sales, stocks declined from 163,462 tons in March to 160,873 tons at the end of June.

Consumption

Deliveries of United States Frasch sulphur to the domestic market during the second quarter of 1958 amounted to 711,242 tons compared with 789,000 tons in the first quarter, a decline of 78,000 tons. As both imports and apparent sales of recovered sulphur were also lower, total apparent domestic consumption of brimstone declined by 119,334 tons (11%) from the preceding quarter and 234,000 tons (19¾%) from the corresponding quarter of 1957 to 954,622 tons. Consumers have continued to run down their stocks and, therefore, actual consumption of brimstone, particularly for sulphuric acid production, did not decline as much.

Sulphuric acid production in the second quarter totalled 3.82 million tons (100% H_2SO_4) compared with 3.93 million tons for the first quarter and 4.11 million tons for the second quarter 1957, representing a decline of 2½% and 7% respectively. During this period the low point of the recession was reached, with most sectors of industry operating at a very low level and the late spring affecting fertilizer demand. Since April there has been a steady, if small, increase in steel production and a rapid rise in the demand for fertilizers, reflected by corresponding movements in acid and sulphur demand. Steel production at the beginning of September has risen to 1,764,000 tons per week or 65.4% of capacity compared with less than 1,500,000 tons at the end of the second quarter. The fertilizer industry increased sales during the second quarter as a result of improving weather and preliminary estimates indicate that by the end of the twelve months ending June 30th they will at least equal sales for the corresponding period of 1956/1957. Preliminary data indicate, however, that fertilizers, in the production of which sulphur plays a part, appear to have lost ground.

New sulphuric acid capacity includes the completion in April of the 500 tons per day spent acid regeneration plant at Beaumont, Texas, by the Olin Mathieson Chemical Corporation. The raw material comes from a nearby oil refinery. In May the sulphuric acid plants of the Stauffer Chemical Company and General Chemicals of San Francisco began operating on pyrites supplied by Mountain Copper Company from the new ore body at Brick Flats. It has also been announced that E.I. du Pont de Nemours & Company have purchased the idle sulphuric acid plant of the Cornwell Chemical Corporation in Cornwell Heights, Pa. The plant has not been operated

Monsanto Chemical Company. General view of the 400 tons per day Leonard-Monsanto plant at Monsanto, Illinois. Plant commenced operation in January, 1953.

for some time, and modification of some equipment will be necessary before production begins at the end of the year.

During the second quarter consumption of non-acid sulphur was still adversely affected by the low level of activity in the paper and tyre industries. Since June, however, production of pulp and paper has been rising and is currently at 90.3% of capacity compared with 91.6% at the corresponding time in 1957. The demand from the rubber industry is also expected to rise as production of the 1959 models begins but it is significant that rayon is reported to have lost the replacement tyre market to nylon. New tyres continue to incorporate high-tenacity rayon. There has been further rationalisation in the United States industry and it is reported that a major viscose rayon filament plant has been closed. The industry is endeavouring to find new uses for established and improved types of rayon yarn and staple.

Trade

United States imports of sulphur from Mexico during the second quarter of 1958 amounted to 96,182 tons compared with 130,320 tons in the previous quarter and 115,000 tons in the corresponding quarter of 1957. This decline in imports from Mexico was occasioned mainly by adjustments in the requisitioning schedules of a number of larger users during this period of low demand.

Exports of crude sulphur in the second quarter, wholly under the control of Sulphur Export Corporation, rose to 449,416 tons compared with 318,519 tons in the preceding quarter, and only 8,000 tons less than in the same quarter of 1957. The United Kingdom

and Canada remained the largest export markets, the tonnage shipped amounting to 89,331 tons and 80,956 tons respectively. Other large markets ranging from 20,000 to 30,000 tons per quarter were Western Germany, Australia, Switzerland, Belgium, Brazil, India, and France. The latter, already 11,000 tons lower than in the second quarter of 1957, is progressively contracting as supplies from Lacq become available in the coming months. Against the corresponding period last year exports to the United Kingdom had risen by 25,000 tons, West Germany 7,000 tons, Switzerland 7,000 tons, and Australia 17,000 tons. On the other hand, exports declined to Belgium by 4,000 tons, India 8,000 tons, Brazil 9,000 tons, and the Union of South Africa 10,000 tons. The decline of exports to Canada, the other major potential supplier of recovered sulphur, amounted to 31,000 tons, the bulk of lost business being centred along the West coast.

Summary

(a) During the second quarter of 1958 production of Frasch and recovered sulphur amounted to 1,345,173 tons, 8% less than in the previous quarter and 7½% less than in the second quarter of 1957.

(b) Apparent sales of Frasch and recovered sulphur totalled 1,307,060 tons in the second quarter, 4% more than in the previous quarter, mainly on account of higher exports but nevertheless about one-quarter million tons (16%) lower than in the corresponding period of 1957. Stocks of Frasch and recovered sulphur rose to 4,882,522 tons compared with 4,784,462 tons in March and 4,231,367 tons in June, 1957.

(c) Exports of Frasch sulphur increased to 449,416 tons compared with 318,519 tons in the previous quarter and 457,382 tons in the second quarter of 1957. Exports of Frasch sulphur for the first six months of 1958 amounted to 767,935 tons and exceeded those for the first half of 1957 by over 20,000 tons and the first half of 1956 by over 15,000 tons.

(d) Imports of Mexican sulphur declined to 96,182 tons compared with 130,320 tons in the preceding quarter and 108,400 tons in the corresponding quarter of 1957.

During the second quarter of 1958 there has been mounting evidence that the bottom of the United States recession has been reached and that recovery is now taking place. As yet the impact of increasing economic activity has not been reflected in the results of the United States sulphur and sulphuric acid industries, but it can be expected that during the third quarter the adverse trend may be halted and possibly reversed.

Whilst domestic consumption has been falling, not only in the United States but also in many European and other overseas markets, exports of Frasch sulphur for the first six months of this year were the highest on record. This apparent contradiction, which is accentuated by simultaneous rise in Mexican exports to new high levels, may be explained partly by the swing away from pyrites use in several European countries and partly by the steady growth of the smaller markets particularly in "under-developed" countries. Much of the success in export markets is, however, due to intensive sales promotion backed by the flexible price policy of Sulexco. Low freights have assisted in this expansion of United States exports, but as this advantage lacks permanency it is insufficient by itself to meet competition from local sources of sulphur. The maintenance of a large United States Frasch sulphur export trade, therefore, seems to become increasingly dependent on agricultural and industrial growth in the under-developed countries of Asia and South America. In this connection the export of sulphur in the form of finished high analysis fertilizer may well play an important part.

As supplies of recovered sulphur from Lacq and from Canada enter world trade, and as competition at home and abroad by Mexican Frasch sulphur and recovered sulphur supplies intensifies, the key to the future prosperity of Frasch sulphur will be found in the size of the U.S. domestic market, in the definition of which the success of the U.S. fertilizer industry in raising their exports will be important. Having enjoyed over the past three decades a high rate of profitability on which expansion plans and operations could be readily founded, it has now become a matter of great urgency that the United States Frasch sulphur industry should determine the level of operations which best accords with the economic and profitable exploitation of this important asset.

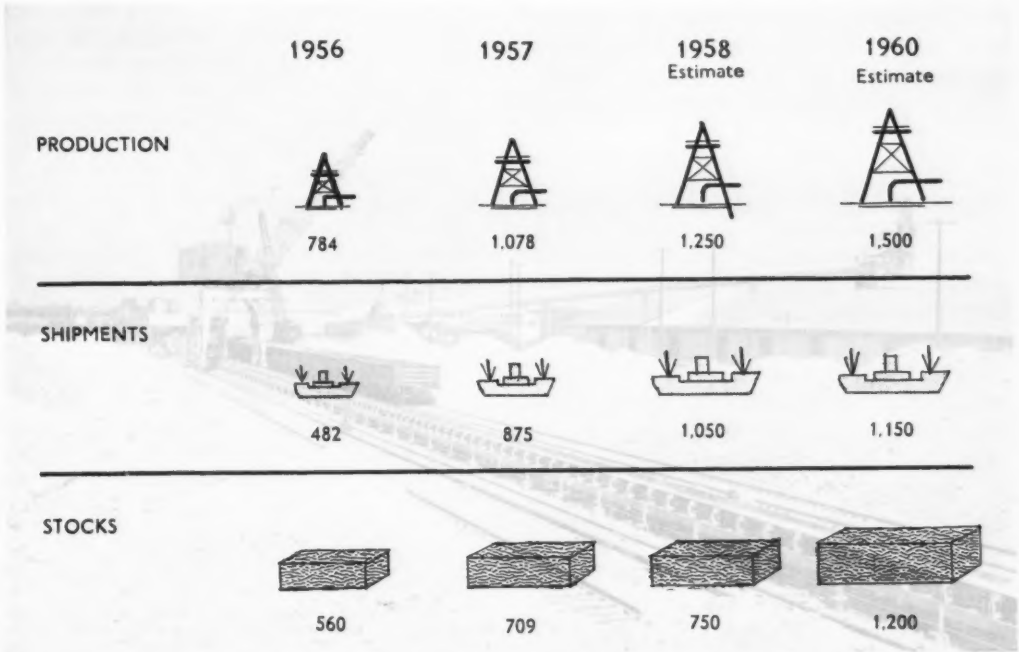
SULPHUR IN MEXICO

DURING THE second quarter of 1958 the Mexican sulphur industry maintained the high level of production and sales which it had achieved earlier this year and which is the highest since operations started nearly four years ago. Mexican exports of Frasch sulphur represented 35% of total world sulphur trade in 1957, and during the first half-year of 1958 the rate of exports has further advanced to an annual level of about one million tons, of which about 55% is destined to the U.S.A. and 45% to the rest of the world. Production in Mexico has also grown steadily to an annual rate of approximately 1¼ million tons, in contrast to the United States where in 1958 Frasch sulphur production has been at a level of 5 million tons, a decline of 11% compared with 1957. Some of the difficulties facing the United States' Frasch industry are now beginning to be felt also by the Mexican producers, although not in respect of current operations, which are supported by an apparently satisfactory order book. Production and sales are nevertheless closely co-ordinated.

Production

Whilst the major part of production was supplied by the Pan American Sulphur Company from its Jaltipan dome, Gulf Sulphur Corporation was able to continue increasing the level of production at Las Salinas. Texas Gulf Sulphur Company maintained output and continued stockpiling at Nopalapa, and Texas International Sulphur Company is still carrying out development work at its Texistipec dome.

Total production of sulphur in Mexico during the period April to June totalled 315,424 tons and was only fractionally more than in the preceding quarter, when it amounted to 314,113 tons; compared with the output of approximately 236,000 tons in the same period of 1957, however, it represents an increase of about one-third. Frasch sulphur accounted for approximately 288,000 tons (91%) of production, the remainder being supplied by the surface mines in San Luis Potosi, which produced 4,475 tons of sulphur ore, and by



Production, shipments and stocks, showing estimates for 1958 and 1960. Photograph depicts Pan American Sulphur Company's second loading installation at Coatzacoalcos.

PEMEX, who recovered approximately 19,000 tons sulphur from natural and oil refinery gases. During July and August production remained at this level.

Exports

Total exports for the second quarter of 1958 amounted to 234,441 tons, fractionally less than in the previous quarter, but 5% more compared with the same period of 1957. Three ships due to have loaded during June were delayed, and it was largely this fact which caused exports for June to decline by 22,000 tons compared with May. Exports in the first six months of 1958 amounted to about 470,000 tons and the indication that this year's exports may exceed one million tons, is corroborated by the volume of shipments in July and August, which raised the monthly average for this year to 87,200 tons.

The Mexican Frasch sulphur industry has secured a nucleus of markets which offer a regular and calculable outlet. The largest is in Florida and along the Eastern Seaboard of the United States and it is served by stock-piles laid down at Tampa and Norfolk. The present level of the U.S. market of about 40,000 tons per month is to a great extent supported by long-term contracts. In Western Europe, Mexican sulphur has generally maintained its position and in some instances even bettered it despite strong competitive pressure by U.S. producers. The current rate of shipments of about 200,000 t.p.a represents about one-quarter of total imports of brimstone from overseas into Western Europe. Australia, Tunisia and South Africa are now established markets for Mexican sulphur, whereas Israel, Formosa and Canada are lesser and more recent outlets.

Domestic Consumption

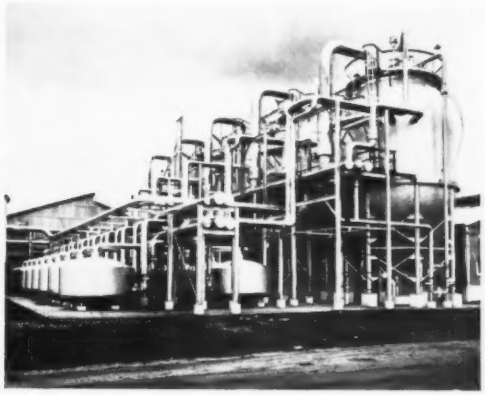
The steady growth in domestic sulphur consumption and future developments in consumer industries are an important factor to all concerned in the Mexican sulphur industry. At present the producers are handicapped by the absence of a substantial domestic demand, particularly at a time of sluggish world trade. During 1957, of total Mexican deliveries of 951,000 tons only about 75,000 tons or 8% went to the domestic market and at the current rate of sales domestic consumption, which by the end of 1958 should have consolidated at an annual rate of 100,000 tons, will account at best for only 9%. By comparison, the United States producers in 1957 enjoyed the benefit of a domestic outlet of approximately 70% of total deliveries.

Domestic sales of sulphur during the second quarter amounted to 20,327 tons, virtually the same as in the previous quarter. Frasch sulphur supplied by Pan American and Gulf Sulphur Companies represented 1,447 tons and the remainder came from Petroleos Mexicanos in the form of recovered brimstone, and from the surface mines at San Luis Potosi. Several new sulphuric acid plants are now entering production or are scheduled to go into operation later this year, thereby giving domestic sulphur consumption a sharp boost. Consolidated Chemicals' 100 tons per day (100% H_2SO_4) acid plant in Zacapu came on stream in March and operations at the acid plant of Guanos y Fertilizantes for the production of ammonium sulphate is imminent. The sulphuric acid installations at the titanium plants of Du Pont S.A. de C.V. at Tampico and Quimicas Basicas S.A. at Vera Cruz, with capacities of 60 and 100 tons per day (100% H_2SO_4) respectively, are due to come on stream by the end of the year. These plants, which are based on brimstone, will increase Mexican sulphuric acid capacity by 105,600 tons (100% H_2SO_4) to over 300,000 tons per annum by the end of the year. Actual production in the region of 250,000 tons (100% H_2SO_4), requiring approximately 100,000 tons of sulphur, is anticipated, an increase of 25%. It is further estimated that by the end of 1960 domestic consumption of sulphur will be trebled which, at the current rates of production, would enable producers to place about one-fifth of their output domestically compared with less than one-fifteenth at present.

PAN AMERICAN SULPHUR COMPANY

By the end of the first half of 1958 the Pan American Sulphur Company had produced 2,179,000 tons of sulphur since operations began in the Autumn of 1954. The second quarter's output amounted to 201,000 tons compared with the previous quarter's 208,000 tons and 164,000 tons in the same period of 1957. Net earnings in the second quarter amounted to $797,784 compared with $760,849 in the previous quarter, resulting from sales of $3,827,436 in the June quarter against

$3,784,897 in the first quarter of the year and $4,055,316 in the corresponding period of 1957, when a higher price was in force. Earnings per share rose to 38 cents against 36 cents in the previous quarter and compared with 45 cents in the same quarter of 1957, when the number of shares outstanding was smaller. In their endeavour to improve the quality of sulphur production the Company's technical staff have applied on plant size scale a further purification process which is reported to provide a saleable product of over 99.9% S purity



Pan American Sulphur Co. water softening and filtration equipment with a daily capacity of 5 million gallons.

with practically no ash or moisture, modest residual carbon content and bright yellow colour. The process is based on dilute sulphuric acid washing of the molten crude sulphur in conjunction with the established activated earth filtering. The process was originally developed in the United Kingdom and in Germany in conjunction with purification of sulphur recovered from spent oxide, Messrs. Hardman & Holden Limited, of Manchester, having been prominent in the original experimental work. Some United States sulphur producers have also worked with it at times but its application at Jaltipan is believed to be the first instance of sizeable plant scale operations. The entire output of Pan American Sulphur Company is now bright but the extent of provision of this highly purified product will depend on prices and demand. In connection with these qualitative considerations it is reliably reported that the crude production at Jaltipan has further improved as greater areas of this rather shallow and extensive dome are being steamed. The carbon content, once over 0.6%, is now consistently at about 0.2%-0.25% C., at least one-third of which is removed by conventional filtering.

Shipments during the second quarter amounted to 181,000 tons against 175,000 tons in the first quarter and 167,000 tons in the corresponding period last year. But for shipping and loading delays at the end of June the quarterly tonnage would have been considerably higher, although partly because of this Pan American Sulphur Company was able to ship 85,509 long tons in July, creating a new monthly record.

Shipments during the second quarter were destined to the United States (57%), Western Europe (26%), Canada (6%), South Africa (6%) and the balance (5%) to Formosa and Tunisia. This level of exports of 725,000 tons per annum compared favourably with the estimate made at the beginning of the year by Mr. Harry C. Webb, the Company's President, and exceeds by 5% the 1957 level of exports of 690,000 tons. Stocks at the end of June further increased by 20,000 tons amounting to just under 600,000 tons or approximately ten months' deliveries at the current rate of shipment.

GULF SULPHUR CORPORATION

Total output at the Company's Las Salinas dome for the second quarter was 66,394 tons, compared with 54,941 tons in the previous quarter. During July a record monthly output of 27,664 tons was achieved and to consolidate the position additional water heating capacity was installed. The management's ability to operate consistently near or in excess of 1,000 tons per day significantly improves the economics and prospect of profitability. Shipments during the second quarter totalled 54,859 tons, about 5,000 tons less than in the previous quarter and about the same as in the second quarter of 1957. This represents an annual level of 230,000 tons which, however, falls short of the 275,000 tons predicted by the Company's Secretary last November. Of the Company's total exports 32% were destined to the U.S.A., Australia accounted for 27%, Israel for 22% and France for 19%. Stocks during the first

six months increased by approximately 6,000 tons, to just under 50,000 tons or two months' commitments. At present sales levels they are still thought to be uncomfortably meagre.

The Company is reported to have reached a mutual understanding with Texas Gulf Sulphur, that an agreement permitting the latter to use Gulf Sulphur's port installations will be signed when Texas Gulf Sulphur decides to ship from Mexico. Loading installations at Wharf 8 Coatzacoalcos are being expanded.

TEXAS GULF SULPHUR COMPANY

The Company's Mexican subsidiary, Cia. Exploradora del Istmo, S.A., is, it is estimated, currently producing at a monthly rate of 7,000 tons, and during the second quarter produced approximately 20,000 tons, all of which was stockpiled. It is thought that the Company is producing well below potential output which is probably in the region of 20,000 tons a month.

Although an understanding regarding the shipment of sulphur has been reached with Gulf Sulphur Corporation, it is unlikely that the Company's policy of stockpiling will be changed in the near future.

PETROLEOS MEXICANOS

Recovered sulphur capacity based on this Company's oil refineries and sour natural gas production is estimated to stand at 240 tons per day with plant operating or under construction at Poza Rico, Mexico City and Tampico. Production during the second quarter was approximately 18,000 tons, and is expected to increase as new plant comes into operation.

Other Activities

Freeport Sulphur Company has now drilled out a large part of the concession in the Isthmus of Tehuantepec but so far without locating any deposits worth commercial exploitation. It is reported that officials of Azufres de Mexico still believe that commercial deposits exist in one end of the concession. In this connection it has been stated that Azufres de Mexico have plans to attempt a new drilling programme.

The assembly of the second-hand extraction plant by Texas International Sulphur Company at the Texistipec dome appears to be proving more difficult than anticipated. Due to this the original completion date of June has now been postponed to November, although no exact reason has been given by the Company.

Conclusion

The impact of lower world sulphur demand and increasing supplies has not yet been fully felt by the Mexican industry, although during the first half of 1958 there have been growing indications that a further increase of sales has become more difficult to achieve.

The situation is particularly significant in so far as it is developing at a time when consolidation in the Mexican industry should be taking place. The future particularly holds anxiety for Gulf Sulphur Corporation which, after raising capacity and output and strengthening the management, have only just started to lift their profitability above the break-even level. Stocks of this Company stand at little over two months' supply and to finance additional stocks it seems that at least the present rate of sales of about one-quarter million tons per annum would have to be maintained.

Pan American Sulphur Company, thanks to her bigger volume of sulphur production and sales, enjoys a greater measure of flexibility. Even so, as both companies are intimately identified with "Mexican Sulphur" their fortunes are interdependent and, in view of the industry's valuable contribution to Mexico's foreign exchange earnings and trading prospects, of great moment to the Government. The growth of Mexico's domestic market although important, cannot afford the ready cushion which might compensate for the probable reduction of Mexican sulphur sales in some European markets before another year has passed. Of necessity, relief will be sought in the large U.S. sulphur market and in other geographically favoured consuming areas. In particular, the potentially large sulphur market in South and Central America could do much to help bridge the gap between a profitable level of operation and available outlets. At present unfavourable shipping facilities and freight rates are a handicap.

The Mexican sulphur industry has built up much goodwill and enjoys many inherent advantages in production and marketing. As the next six to twelve months pass its strength will be increasingly severely tested.

UNITED KINGDOM SULPHUR

CONSUMPTION of sulphur in all forms* in the second quarter of 1958 amounted to 212,000 tons, having receded substantially partly under the influence of the lower level of overall industrial activity. Compared with 243,000 tons in the previous quarter and 238,000 tons in the corresponding period of 1957, this rate of sulphur use represents declines of 13% and 11% respectively. Imported brimstone and filter cake accounted for 38½% of the total consumption, imported pyrites 18%, anhydrite and spent oxide and other indigenous sulphur supplies in the form of zinc smelter gases and recovered sulphur accounted for the balance of 43½%. The following table shows an analysis of consumption :—

	2nd Quarter 1958	1st Quarter 1958	% Change	2nd Quarter 1957	% Change
Elemental Sulphur:—					
Total Acid	72,800	87,300	— 16½	84,500	— 14
Imported	63,700	76,100	— 16¼	75,400	— 15½
Recovered, H_2S and filter cake	9,100	11,200	— 18¼	9,100	—
Non-Acid	21,100	26,100	— 19¼	29,000	— 27½
Total Elemental Sulphur	93,900	113,400	— 17¼	113,500	— 17½
Pyrites	81,200	96,700	— 16	92,200	— 12
Spent Oxide	63,700	67,500	— 5¾	68,400	— 6¼
Anhydrite	176,600	193,100	— 8½	176,300	—
Zinc Concentrates	36,600	36,700	— ¼	37,800	— 3¼

Brimstone consumption for acid manufacture was the lowest since the third quarter of 1956 and reduced non-acid uses have brought total brimstone consumption to the lowest level for many years.

Pyrites usage declined partly as the result of some smaller plants being closed down but also because of the lower acid demand of the rayon industry, particularly of Courtaulds Limited, one of the largest consumers of pyrites in the United Kingdom.

The use of sulphur from zinc smelter gases has remained fairly stable for the past nine months in common with the level of zinc output. Anhydrite consumption declined by just over 16,000 tons from the previous quarter, presumably due to customary seasonal maintenance, and at 176,593 tons is a little higher than the corresponding quarter of 1957.

Supplies

During the second quarter sulphur imports in the form of brimstone and pyrites of 99,000 tons declined to their lowest quarterly level for over ten years. This compares with 109,700 tons in the preceding quarter and 124,800 tons during the second quarter of 1957. Compared with the production of acid the low levels of imports indicate considerable drawing upon stocks, this was particularly true of pyrites where stocks at some of the pyrite roasting acid plants may now be run down in preparation for the closing of the plants.

The bulk of brimstone imports of 72,900 tons originated from the United States (61,100 tons) and Mexico (11,800 tons). This compares with 81,600 tons in the preceding quarter and 76,800 tons in the corresponding quarter of 1957. At this lower level of imports during the second quarter supplies from the United States represented a larger percentage of total imports while those from Mexico lost some ground. The average import value of brimstone was £11 13s. per ton against £12 4s. in the preceding quarter and £16 0s. in the corresponding quarter of 1957, when both higher f.o.b. prices and higher freights were in force.

Pyrites imports at 52,500 tons were only slightly larger than the preceding quarter's tonnage of 51,900 tons and it is evident that consumers continue running down stocks. A comparison with imports of 100,900 tons in the corresponding period of 1957 is, however, unsatisfactory as in the second quarter of 1957 imports were inflated by the greater volume of shipments in order to fulfil contracts. The average import value of £5 0s. per ton during

* Not including sulphur in anhydrite used for direct manufacture of ammonium sulphate, estimated at about 205,000 tons per annum.

the second quarter compared with £6 3s. in the preceding quarter and £8 0s. in the corresponding quarter of 1957 when it was the highest on record. Sources of supply were Cyprus (34,500 tons), Spain (7,700 tons), Canada (5,300 tons) and Sweden (4,300 tons).

Sulphuric Acid Production

The decline in sulphuric acid production continued during the second quarter of 1958 and assumed significant proportions. Total production of 531,919 tons (100% H_2SO_4) showed a decline of 79,595 tons from the preceding quarter and compared with 586,758 tons (100% H_2SO_4) during the second quarter of 1957. Installed capacity in the second quarter rose to 701,260 tons, fractionally greater than at the same time in 1957. Contact plant capacity increased about 4% to 541,090 tons (100% H_2SO_4) from 520,890 tons in the previous quarter and 518,880 tons (100% H_2SO_4) in June, 1957; whereas capacity rose, the level of employment of plant declined from 90.3% in the first quarter to 76.4% in the second quarter of 1958. Although chamber and tower capacity decreased slightly from 161,550 tons (100% H_2SO_4) to 160,170 tons during the quarter it maintained its share of the lower level of production at approximately 23½%.

The different raw materials used in the production of sulphuric acid were as follows: -

	2nd Qtr. 1958 %	*1st Qtr. 1958 %*	*2nd Qtr. 1957%*
Elemental Sulphur:—			
Imported Brimstone ...	33¼	35	36
Recovered H_2S, Filter Cake	4¼	5	4½
Sulphur in:—			
Pyrites	20¼	21½	21
Spent Oxide	16	15	15½
Anhydrite	20	18½	17¼
Zinc Concentrates ...	5¼	5	5½
Total Sulphur '000 tons	191	218	209

The decline in the proportion of brimstone acid at a time of lower overall acid production is an unusual feature. This is attributable to sustained anhydrite acid operations, which for reasons of economy are not flexible, the steady level of smelter acid output and the low cost of spent oxide which made it attractive to acid makers. Also adversely affected were pyrites which, in the period under review, had not yet the benefit of lower prices.

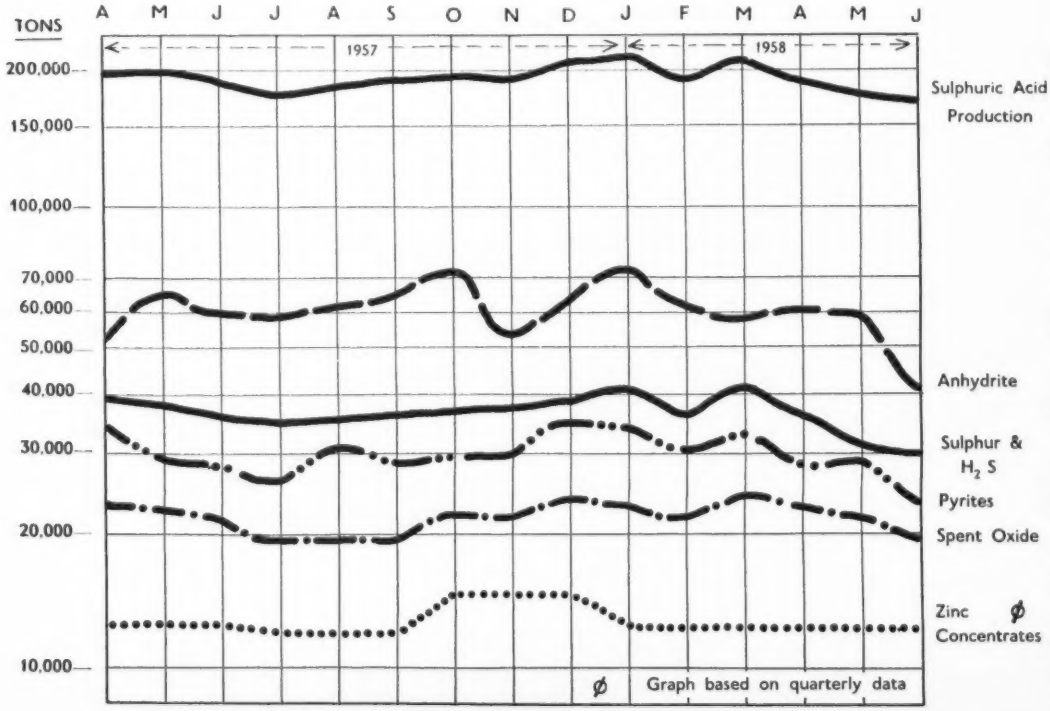


Fig. 6. Monthly consumption of raw materials and production of sulphuric acid.

The increase in installed capacity of 20,000 tons (100% H_2SO_4) during the quarter is attributable to three new contact plants coming on stream; Fisons Limited at Immingham, Laporte Titanium Limited at Stallingborough and British Titan Products Limited at Grimsby, the last named starting at the end of June.

Sulphuric Acid Consumption

The decline in sulphuric acid use which became apparent in the first quarter of the year gathered impetus during the second quarter when total acid consumption (100% H_2SO_4) declined to 539,000 tons compared with 615,000 tons in the preceding quarter and 583,000 tons in the corresponding period of 1957.

	2nd Qtr. 1958	%	*1st Qtr. 1958*	%	*2nd Qtr. 1957*
	000 tons	*Change**	*000 tons*	*Change**	*000 tons*
Fertilizers	189	−20.2	237	− 4	197
Chemicals	69	− 4.2	72	−12.7	79
Titanium Dioxide	74	−15	87	− 6.3	79
Rayon and Transparent Paper	62	− 4.6	65	−18.4	76
Metallurgy	30	− 6.2	32	− 9	33
Oil Refining	12	−14.3	13	−20	15
Dyes	19	− 5	20	−20.8	24
Soaps and Detergents	29	—	29	+31.8	22
Plastics	10	—	10	+11.1	9
Miscellaneous	45	− 6.2	48	− 8.2	49
Total	539	−12.3	615	− 7.6	583

* Percentage change compares the second quarter with earlier periods shown.

Soap and detergents and plastics were the only consuming industries which used more acid. The decline in acid consumption for both superphosphate and ammonium sulphate continued and, although the second quarter is normally a period of slack demand, a trend towards lower consumption of these fertilizers is appearing. The outstanding feature in the pattern of acid consumption is the sharp decline in usage of sulphuric acid by the titanium industry. Although this check to progress is considered only temporary, it is some measure of the lower level of overall acid demand that one of the foremost growth industries should be so affected.

Non-Acid Sulphur

Consumption of brimstone in the non-acid sector is estimated to have fallen to 21,000 tons, a decrease of 5,000 tons from the preceding quarter and of nearly 8,000 tons from the level of usage in spring 1957. The main cause is to be found in the unfavourable conditions in the man-made fibre industry where in June output was 21% lower than at the beginning of the year. The gravity of the position in the acetate and in the viscose rayon sectors of the industry will be appreciated if it is borne in mind that the synthetic fibres output continues to boom. The transparent paper industry, where demand moves forward as a result of the rapid growth in packaging, provides a bright spot for viscose pulp and non-acid sulphur use. The reduction in tyre manufacture during the second quarter which affected viscose staple usage also made itself adversely felt in the sulphur requirements of the rubber industry. Other non-acid sulphur uses remained static or showed a modest contraction.

Summary

Significant developments in the United Kingdom sulphur industry in the second quarter of 1958 are as follows:—

(a) Consumption of sulphur in all forms declined to 212,000 tons; brimstone use declining proportionally more than the use of indigenous raw materials, notably anhydrite and spent oxide.

(b) Sulphur imports in the form of brimstone and pyrites of about 99,000 tons were the lowest for over ten years.

(c) Consumption of sulphuric acid declined to 538,600 tons (100% H_2SO_4), 7½% less than in the corresponding quarter of 1957.

The trend toward greater brimstone usage for acid manufacture has been checked, but as the new brimstone plants come on stream this trend should once more become evident.

Although the decline in sulphuric acid consumption is indicative of a considerable slackening in nearly all sectors of industry, the economy of the United Kingdom is in a stronger position to withstand recessionary

forces than for some time. It is not expected that there will be an upturn before the end of the year but the balance between the present situation and expansion is still very close and industry might profitably use present conditions for the overhaul of facilities and consolidation of a basically sound position.

With regard to demand for non-acid sulphur it is becoming more apparent that the present fortunes of the rayon industry are not due to a cyclical fluctuation but a structural change in demand resulting from new materials and overseas competition. Consumption of sulphur in this sector of the industry may, therefore, decline even further.

The recent price reductions by Spanish and Cypriot producers do not appear to have affected demand, and in face of the swing towards brimstone, which is to some extent technical, there are no indications that these price reductions are reversing the trend.

In the meantime it may be expected that pyrites acid manufacturers operating large plants of modern design will be instrumental in establishing a new level of pyrite consumption at about 250,000 tons per annum, which in view of the lower pyrites prices they should be able to maintain. In this respect demand favours ores with low arsenic and non-ferrous metal content.

As the world's largest importer of brimstone the United Kingdom enjoys the benefit of a buyer's market. Shipments of French recovered sulphur are starting this autumn and may be expected to attain an annual rate of 100,000 tons next year. United States and Mexican Frasch sulphur producers are vigorously competing for the balance, which is being progressively reduced by supplies of indigenous recovered sulphur.

The prevailing low cost of shipping at a time of cheap competitive sulphur provides the United Kingdom sulphur industry with an opportunity to improve the economics of its activities especially in providing lower cost sulphuric acid.

CYPRUS PYRITES IN 1957

PRODUCERS FACE LOWER PRICES

The Annual Report of the Inspector of Mines shows that the quantity of mineral products exported from Cyprus during 1957 was slightly higher than in 1956, but that the total value of these exports fell from £13,845,254 in 1956 to £10,440,691 in 1957, due to lower prices received for copper and sulphur materials. Cypriot pyrites producers encountered increasing competition from brimstone and the volume of exports was only maintained because, in common with other European pyrites producers, lower prices were accepted. As the result of the lower prices for copper and sulphur materials the mining industry could account for only 60% of the total value of domestic exports from the Colony, the same as in 1954 and 1955, compared with 67% in 1956.

	1955	*1956*	*1957*
Copper pyrites	139,230	171,032	226,334
Iron pyrites	753,640	821,727	762,501
Total Exports (long tons)	892,870	992,759	988,835

Exports of Iron and Copper Pyrites

Total exports of pyrites in 1957 were exceeded only by those of Spain. Shipments to Western Germany totalled 298,300 tons (33%) followed by almost equal amounts to the Netherlands and the United Kingdom (18% each). Italy (16%) and France (14%) were the other major destinations.

Cyprus Mines Corporation

Operations at the Mavrovouni mine were at the same level as in 1956, 923,831 tons of ore being extracted, compared with 933,685 tons in the previous year. From the ore delivered to the treatment plant at Xeros, 176,255 tons, averaging 48.33% sulphur and 3.15% copper, were crushed and screened for shipment as copper pyrites. The treatment plant also produced 529,871 tons of "flotation pyrites" with an average of 49.9% sulphur and 112,434 tons of copper concentrates. Exports by the Cyprus Mines Corporation during 1957 included 171,852 tons of copper pyrites, Western Germany receiving 90,705 tons and Italy 81,147 tons. 440,538 tons of "flotation pyrites" were shipped, of which 179,715 tons were sent to the United Kingdom, 138,507 tons to France, 85,915 tons to Holland, 14,745 tons to Belgium and smaller quantities

to Egypt, Western Germany and Italy. 138,382 tons of copper concentrates were exported, 107,137 tons being shipped to Western Germany and 31,245 tons to the United States of America. The company's mines at Skouriotissa and Apliki remained closed throughout the year, although at the Apliki mine a small labour force was employed on rehabilitation work for the intended resumption of underground operations in 1960.

Hellenic Mining Co. Ltd.

The Hellenic Mining Co. Ltd. operate eleven mines, including those at Kalavassos, Petra, Kambia and Agrokipia. Underground operations at the Kalavassos and Petra mines were resumed early in 1957 following the settlement of a labour dispute which occurred in the latter half of 1956, although on a much reduced scale compared with previous years as the company are finding difficulty in recruiting a sufficient number of skilled miners in this area.

The company now has two treatment plants in operation. One is at Vasiliko and the other is a new plant built at Mitsero to handle ore mined at the Kambia-Sha and Agrokipia leases. During 1957 the Mitsero plant treated 343,395 tons of low grade ore producing 111,217 tons of commercial grade ore.

A total of 305,955 tons of pyrites, containing an average of 47.5% sulphur, were produced by the Hellenic Mining Co. Ltd. in 1957, compared with 299,857 tons in 1956. The total tonnage of pyrites exported by this company during 1957 amounted to 312,303 tons, of which Western Germany received 223,279 tons, Italy 72,645 tons, Czechoslovakia 14,179 tons, and Holland 2,200 tons. This is an increase of 4% over the tonnage exported in 1956.

Cyprus Sulphur & Copper Co. Ltd.

Open-cast operations were started by the Cyprus Sulphur & Copper Co. Ltd. at the Kinousa mine in 1957 and yielded 37,733 tons of pyrites. Underground operations at this mine produced 30,873 tons compared with 41,709 tons in 1956. No ore was extracted from the Limni mine during 1957, although work was carried out with a view to the resumption of mining operations there in the near future.

Exports by the Cyprus Sulphur & Copper Co. Ltd. in 1957 amounted to 54,482 tons of copper pyrites of which 31,315 tons were shipped to Holland and 23,167 tons to Western Germany. In addition, 9,660 tons of iron pyrites were shipped from stocks to Holland. The majority of shipments took place during the first half of the year and before work on the mechanisation of the loading jetty at Mavroli was started. This work was almost completed by the end of the year.

Outlook

Shipments of pyrites during the first six months of 1958 have been maintained at the same level as in 1957, despite the adverse effect on pyrites consumption of the increasing use of brimstone for acid production. The position of Cyprus producers as exporters of pyrites to Western Europe has been improved generally by low freight rates which have reduced their geographical disadvantage in competing with Spanish, Norwegian and other producers. In consequence, the volume of exports is likely to be maintained, although the reduced prices will bring poorer financial results to producing companies.

Cyprus exporters are likely to maintain the increasing share they have taken of Dutch pyrites imports, mainly at the expense of Spanish producers. Exports of iron pyrites to the United Kingdom have fallen during the first half of 1958 due to the increasing use of brimstone for sulphuric acid production and to the lower level of industrial activity which has caused pyrites consumers to reduce their stocks. On the other hand, Cyprus producers have been to some extent compensated by the exceptionally high level of industrial activity in France, where imports of Cyprus pyrites are rising and should reach a total of 200,000 tons by the end of the year. Exports of both iron and copper pyrites to Italy have also been increasing, mainly due to growing production of sulphuric acid to meet the requirements of Italy's agricultural policy.

The political unrest in Cyprus has had little effect on the activities of the pyrites mines to date, although any marked worsening of the situation could easily lead to their sudden and complete closure, especially as skilled labour is in short supply. This would have a very serious effect on the finances of the Cyprus Government which derives a substantial proportion of its income from taxes imposed on the mining industry.

Sulphur in Communist Countries

THE RAPID EXPANSION of production facilities and output of inorganic chemicals and fertilizers plays a prominent part in the industrial development plans of all Communist countries. In this review, the first of a regular feature in "*Sulphur*," recent developments in the respective sulphur industries in the various countries are described. The feature that claims the interest of the free world is the current progress of expansion of fertilizer manufacture and supply of raw materials. Although at the present stage of development the respective production attainments are insufficient to meet the domestic needs, and on the basis of published plans will remain so for at least five years, it is evident that production and the destination of supplies are influenced by political dictates which may disregard the domestic economic interests.

Technologically, the U.S.S.R. is unquestionably far ahead of her lesser neighbours and also the scale of activities and the extent of her varied fertilizer raw material resources tend to overshadow developments elsewhere. These reports of specific achievements and plans. Thanks to the extensive work on comparative statistics by the United Nations Economic Commission for Europe there is a yardstick for, and perhaps better understanding of, developments in Eastern Europe and the U.S.S.R. The latest reports of industrial production is tabulated below.

The growth of inorganic chemicals output has generally been in line with or slightly greater than the above rates of increase.

Rise of Gross Industrial Output over the Corresponding Period of the Previous Year

	Year 1957	*First Half 1958*	
	Actual	*Actual*	*Plan*
Soviet Union	10 %	10½ %	6 %
Albania	26 %	19½ %	18 %
Bulgaria	15 %	18 %	12 %
Czechoslovakia	10 %	11 %	8 %
Eastern Germany	7½ %	12 %	8 %
Poland	9½ %	10½ %	5 %
Rumania (Socialist industry)	8½ %	10 %	8 %

BULGARIA

The new sulphuric acid plant commissioned in June, 1957, at the Stalin Chemical Combine at Dimitrovgrad is reported to have raised Bulgarian acid capacity by 150%. Now at an annual level of 35,000 tons, Bulgarian sulphuric acid production is based on the use of domestic copper and iron pyrites. Under 7,000 tons a year in 1939, sulphuric acid production has been progressively increased since the war; 19,000 tons were produced in 1955 and 28,600 tons in 1956. Acid manufacture is centred at Dimitrovgrad where Bulgaria's first superphosphate fertilizer plant came into operation last year. With an initial capacity of 100,000 metric tons a year, the plant is to be expanded to a capacity of 400,000 tons over the next three years. The raw materials used in the plant will come from Bulgarian resources. The recently announced directives of Bulgaria's third Five Year Plan emphasize the priority being given to the chemical industry and call for the increase of Bulgaria's sulphuric acid production to 290,000 tons a year by 1962, a figure which would appear to be optimistic. An important bearing on the Bulgarian sulphur industry is the planned exploitation of the large non-ferrous metal deposits. By 1962 annual

should not, however, be disregarded. The smaller Communist countries are situated relatively close to Western industries and in some instances have similar sources of raw materials supplies whilst China has an immense potential fertilizer demand and is alleged to possess large undeveloped resources, particularly of sulphur and phosphate rock. Because of the unprecedented scale of projected Chinese fertilizer operations, their realisation or failure could equally have profound repercussions in the West; this applies especially to the assessment of China as an outlet for growing world sulphur supplies. In view of this perhaps the most urgent need for the free world is to assign the correct interpretation to the official Chinese

output of zinc and lead ore is to reach three million tons and of copper ores one million tons. By-product flotation pyrites and sulphuric acid will inevitably form part of the projects which are to be based on the pattern of the U.S.S.R. chemo-metallurgical combines.

CHINA

China is making determined efforts to reach the targets of her current five-year plan, which call for an increase in chemical fertilizer production from the present annual level of 900,000 tons to over 15 million tons a year by 1962. Any expansion approaching this target will demand a considerable increase in sulphuric acid production over the present annual level of 300,000 tons, and it is intended to increase capacity from 450,000 tons to between 4 and 5 million tons a year by 1962.

The current programme of new construction for the Chinese fertilizer industry includes several very large plants. Work on the erection of a 600,000 ton per annum mineral fertilizer plant in Kweizang province began in April, while in May work was started on the construction of a fertilizer plant at Kaifeng in Honan province with a planned annual capacity of over one million tons. This plant is to become the centre of a network of chemical factories throughout the province. With the completion of the first stage in 1959, production will include 200,000 tons of phosphate fertilizers, and at a later stage triple superphosphate will be manufactured.

There is considerable construction activity at Canton. A nitrogen fertilizer plant is being built to produce 210,000 tons of ammonium sulphate annually, while a phosphate fertilizer plant is being built to produce 200,000 tons of superphosphate a year. Erection of the first large mechanical fertilizer plant to be built in Yunnan province has started at Kunming. Production from this plant, which is to a large extent automatically operated, is to include 200,000 tons of triple superphosphate a year. At Nanking, operations at the important new fertilizer works have started ahead of schedule. This factory is equipped with an ore-dressing plant with an annual capacity of 300,000 tons of phosphate concentrates, and production will include 200,000 tons of calcium superphosphate.

In all, 17 major fertilizer works are under construction in China, in addition to 66 smaller plants for which most of the equipment is being supplied by Chinese factories. When in operation these new plants will increase China's present fertilizer capacity by 2,700,000 tons.

The expansion of fertilizer production is resulting in the extended use of other sulphur-bearing raw materials for acid production in certain areas. Construction projects in Manchuria include several sulphuric acid plants to allow for the expansion of fertilizer production. Formerly the acid requirements of the many existing fertilizer plants in the province were brought by rail from Nanking, but much of the increased demand will be met by acid manufactured from Manchuria's considerable reserves of copper and iron pyrites. The use of pyrites in other regions of China can also be expected to increase as there are indications that some brimstone is being recovered from pyrites. The Ministry of Petroleum has recently announced that sulphur is to be recovered at an oil refinery with an annual capacity of 3 million tons of crude, to be built at Nanking.

The ambitious programme for expansion announced by the Ministry of Chemical Industry shows a strong emphasis on increased fertilizer production and nearly half their planned expenditure is devoted to this end. Considerable attention is also being paid to research and development and to the training of engineers for the fertilizer industry. The Chinese Government is now proclaiming that when the Communists took over in 1949 the country's total fertilizer production amounted to only 27,000 tons of ammonium sulphate annually and that production of phosphate fertilizers was non-existent; now it is claimed that, within four years, China's production of both sulphuric acid and chemical fertilizers of all types will surpass that of Great Britain.

Chinese fertilizer production may well fall short of the ambitious targets set by the five-year plan, but it is expanding to such an extent that already China is able to influence drastically the market in Asia. Regardless of her own fertilizer requirements, she is quite capable of disrupting the market for purely political reasons. An example of this is her abrupt suspension of trade with Japan, hitherto her foremost supplier of fertilizers. Whereas in 1956 China used 17,000 tons of shipping space for fertilizer imports, this year, in her efforts to obtain alternative supplies from countries

other than Japan, she reserved 317,000 tons of shipping space in the first half alone.

The requirements of her fertilizer industry will absorb the bulk of the sulphuric acid manufactured in China, but the expansion is intended to make available considerable quantities for industrial consumption. Well aware of its importance to her economy, China is energetically expanding her production of sulphuric acid in her efforts to feed her vast and fast increasing population and to emerge as a great industrial power.

CZECHOSLOVAKIA

The latest Five Year Plans, for 1956-61 and 1960-65, emphasise expansion in the chemical industry and the need to catch up on world standards in this industry. This expansion programme, which has already begun, includes a 50% increase in the production of sulphuric acid, increased production of phosphatic and nitrogenous fertilizers from existing plants and the construction of new fertilizer factories.

The production of sulphuric acid by the State organisation Centro-Chemia has increased at an annual rate of about 10% each year since 1953 to 445,000 tons in 1957. Acid is made almost entirely from pyrites which are imported mainly from within the Soviet Bloc, and to a lesser extent from Western European countries, including Cyprus, Norway, Yugoslavia, Greece and Sweden. Over 80% of this sulphuric acid is produced by the contact process. Apart from pyrites used in the production of sulphuric acid, non-arsenical pyrites are imported in large quantities for use in the paper-making industry.

In 1956 it was reported that pyrites deposits had been discovered which would be sufficient to supply the Czech chemical industry for several years. There has been no news of the development of these deposits.

Sulphuric Acid and Fertilizer Production—Thousand Metric Tons

	100% H_2SO_4	P_2O_5	N
1948	215	54	29
1953	311	67	35
1954	341	81	39
1955	383	98	60
1956	422	107	64
1957	445	110	74

EAST GERMANY

East German production of sulphur in all its forms in 1957 is estimated at about one-quarter million metric tons; 102,000 tons of elemental sulphur, 54,000 tons in pyrites and the remainder from gypsum and smelter gases. In addition about 200,000 tons of sulphur are contained in ammonium sulphate made at Leuna by the gypsum/CO_2 process. Elemental sulphur is produced at the Leunawerke from gases produced from the burning of local lignite.

Sulphuric acid production has more than doubled since 1950 to 639,000 metric tons in 1957. Before 1954, the industry was almost entirely dependent on imported and a small quantity of indigenous pyrites. It was then decided to overcome the serious shortage of acid by building plants which would use indigenous gypsum as the raw material. A plant at Wolfen, with an annual capacity of 170,000 tons, was completed in 1954 and one at Coswig, with a similar design capacity, should be completed next year. Already, two acid units are in operation at Coswig. The gypsum acid plant which was built at Wolfen before the war and which by 1943 reached an output of 400,000 tons of acid a year was dismantled in 1945 and taken to the US.S.R. as part of reparations. As far as is known it has not again been in regular production.

In the first six months of 1958, production of sulphuric acid was 9,600 tons short of consumption. Following this disclosure, plans have been annouced for the construction of new capacity which will raise output to one million tons by 1970. These plans include a second gypsum-based plant at Coswig which will be producing 60,000 tons of acid by 1960 and have a final capacity of 220,000 tons to be reached in 1963. Yet another gypsum-based plant with the same capacity as this second plant at Coswig is to be built as part of the third Five Year Plan. In addition to these two gypsum-based plants, two new plants are to be built at Oranienburg and Salzwedel and acid capacity doubled at Premnitz. Pyrites will be used at these factories.

In 1956, over 50% of sulphuric acid was made from imported pyrites and only about 25% from gypsum. The plans mentioned above will change this picture; it is estimated that

by 1960 gypsum will supply about 50% of East German sulphuric acid and as much as 70% by 1970 unless by then Polish sulphur enters into the supply picture.

A relatively small proportion of the sulphuric acid produced in Eastern Germany is used in the production of fertilizers. About 25% is consumed in the production of superphosphates. The current Five Year Plan also provides for an increase in superphosphate and phosphoric acid capacity. It is estimated that production of superphosphates will approach 120,000 metric tons P_2O_5 in 1960, compared with 73,000 tons in 1957. A considerable quantity of sulphate of ammonia is made at Leuna, but since the gypsum process is used, sulphuric acid is not required to convert the ammonia to sulphate. The following table shows the consumption pattern in 1956 :—

	%
Man-made Fibres	25.9
Superphosphates	23.9
Mining	22.8
Insecticides	4.1
Oil production	2.2
Leaching	1.3
Organic Chemistry	14.3
Others and Exports	5.5
Total ('000 metric tons 100% H_2SO_4)	614

HUNGARY

The Hungarian Government is seriously concerned at the low crop yields compared to those in neighbouring Communist countries where far more fertilizer is being used. Its aim in recent years has therefore been to increase the output of nitrogen fertilizers and, to a lesser extent, of superphosphates. Three new chemical combines at Pet, Kazincbarcika (Borsod) and Tiszapalkonya will raise nitrogenous fertilizer output by seven times between 1956 and 1960, and the new superphosphate plant at Szolnok will double sulphuric acid and superphosphate output in the same period.

Production ('000 Metric Tons)	*1956*	*1957*	*1960 (Planned)*
Sulphuric Acid ... (*100% H_2SO_4*)	101	115	200
Superphosphate ...	150	164	300

The Soviet Union is helping finance this expansion programme by a credit of 300 million roubles and has promised to supply equipment for an expansion in capacity at the Kazincbarcika plant and for yet another fertilizer plant which will be built after 1960.

Meanwhile Hungary is increasing imports of fertilizer, which in the first few months of 1958 are 10% above last year's level.

This country is dependent on imported pyrites for the production of sulphuric acid. In 1957, total imports were 130,000 metric tons, of which 35,000 tons were supplied by Yugoslavia. It is claimed that the use of imported pyrites has made sulphuric acid expensive to produce. Therefore since 1956 considerable quantities of Nifosz have been produced. This fertilizer is made by reacting nitric acid on phosphate rock and is said to be less expensive than superphosphate.

Successful test runs have recently been completed at the Danube steel works at Sztalinvaros with a new sulphur recovery plant. Built at a cost of £750,000, the plant has an annual capacity to produce 1,700 tons of sulphur.

NORTH KOREA

North Korea's first Five-Year Plan calls for an increase in sulphuric acid production to 310,000 tons by 1961. During the Korean war all the country's sulphuric acid plants were destroyed or heavily damaged and production, which is based on the use of domestic pyrites, has not so far risen above the level of 50,000 tons a year.

The projected expansion of sulphuric acid manufacture is closely connected with increases in the production of chemical fertilizers called for in the Five-Year Plan. The importance of expansion and new construction in the fertilizer field is emphasised by the law on this Plan which the North Korean Parliament passed on the 11th June, 1958. Production of chemical fertilizers amounted to 195,000 tons in 1956, 323,000 tons in 1957, and is to be increased to 630,000 tons a year by 1961.

Construction has recently been started of a superphosphate plant at Hungnam with a capacity of 100,000 tons a year. A sulphuric acid plant came into operation at Hungnam on 31st July this year and has been producing acid at the rate of 100 tons a day. As a result of Soviet aid the Hungnam fertilizer factory has been equipped with an ammonia synthesis unit and has an annual capacity of 400,000 tons of ammonium sulphate and ammonium nitrate.

A superphosphate works is now being built at Nampo, and when completed will have a capacity of 50,000 tons a year, while other construction activities include the installation at the Tanchong magnesia factory of a plant with an annual capacity of 3,000 tons of magnesium sulphate.

The current programme of plant construction in North Korea is already bearing fruit. In the first six months of the year fertilizer production exceeded that of last year by 48,460 tons and it is expected that production for the year will be about 480,000 tons, an increase of 50% over the total for 1957.

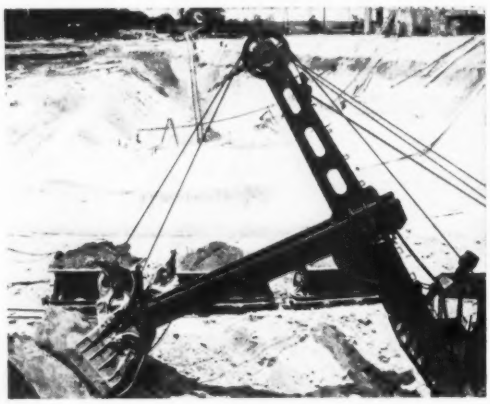
POLAND

Sulphuric acid production in Poland is rising steadily and has now reached the level of one-half million tons a year. Production in the period January to March, 1958, was 2,500 tons over the planned target for the year, which is 11.5% higher than the target of 1956. Even so, it is doubtful whether the target of 723,000 tons in 1960 will be achieved.

Production of sulphuric acid (000 tons 100% H_2SO_4) has been as follows :—

1939	...	200	1955	...	448
1947	...	120	1956	...	480
1950	...	285	1957	...	490
1953	...	370	1958	...	524
1954	...	419	1960	...	723
			(Planned)		

Work on the construction of a new sulphuric acid plant at Torun in North Poland has been started this year; although not due for completion before the end of 1959 it is likely to come into operation before then. The plant is based on the use of brimstone and is to form part of the Torun phosphorus combine. As Poland lacks previous experience in the construction of a plant of this type, some of the equipment is being bought in France. In common with general practice in West Europe the plant will not be housed, and heat recovered from sulphur combustion will be used to make steam. The new installations are to serve as a pilot plant for the sulphuric acid works to be built at Tarnobrzeg as part of a large combine situated close to the sulphur deposits.



Removal of the overburden at the Tarnobrzeg sulphur deposit.

RUMANIA

Three consecutive Five Year Plans to 1970 invisage a large-scale programme for developing the chemical industry, including the fertilizer section. The 1956-60 programme aims at a four-fold increase in the production of chemical fertilizers and includes plans for the construction of three new sulphuric acid plants and two phosphatic fertilizer factories. Superphosphate facilities are due to be completed this year at the Petru Poni plant at Valea Calugareasca and at Navodari. Capacity at Petru Poni will include 30,000 tons of sulphuric acid annually and 200,000 tons of superphosphates. The Navodari factory will have a capacity of 150,000 tons of superphosphates a year and its sulphuric acid requirements will be supplied from an integrated plant. The third new sulphuric acid plant, in the Copsa Mica region, was completed in 1957. It has an annual capacity of 30,000 tons and has raised total Rumanian output of sulphuric acid from 92,000 metric tons in 1955 to an estimated 130,000 tons in 1957. The two acid plants to be completed this year will contribute to planned output in 1960 of 210,000 tons sulphuric acid.

Nitrogenous fertilizer production will also be increased. A large factory is under construction in the province of Moldavia and will have a capacity of some 150,000 to 200,000 tons of fertilizer a year. Ammonium sulphate is already produced at the Hunedoara colliery and metallurgical combine, and will soon be produced at the synthetic fibre plant under construction north of Jassy. Facilities have also been installed at Hunedoara to recover sulphur from coking gases. Formerly, Rumania has had to import all her sulphur requirements.

U.S.S.R.

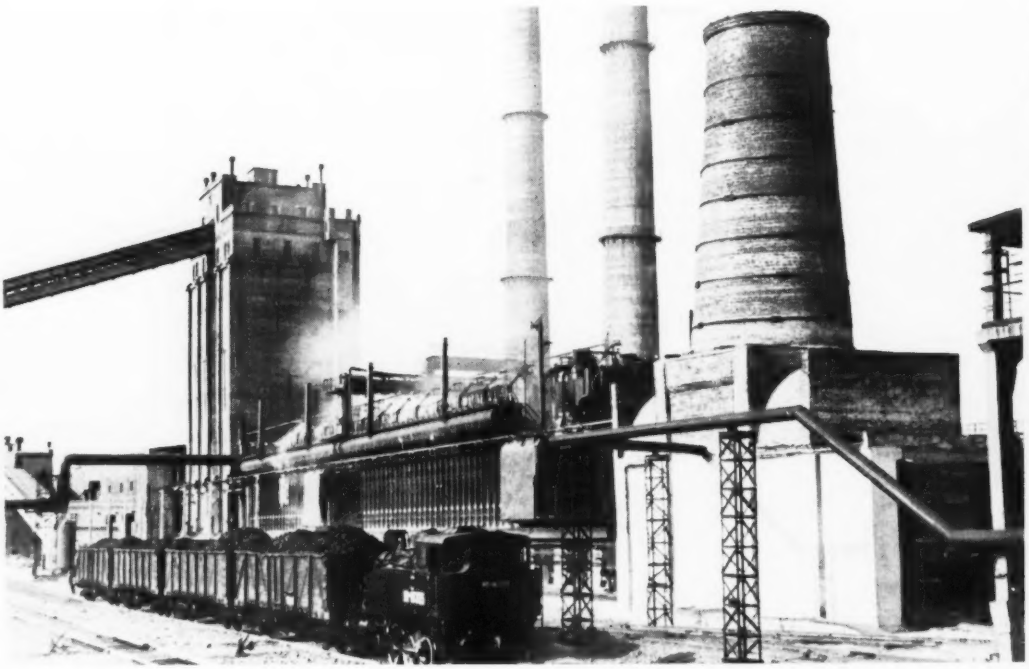
The Soviet Union's ambitious plans for economic expansion are, to a great extent, dependent on the ability of her chemical industry to provide her with enough of the sulphuric acid required by her fertilizer, metallurgical and synthetic fibre industries. Although to-day in the region of five million tons a year, the Soviet Union's sulphuric acid production is still inadequate in relation to her industrial and agricultural capacity. Aware of the vital importance of agriculture to her economy, the Soviet Union is paying close attention to raising her production of fertilizers which has increased remarkably since 1950 when 5 million tons were manufactured; 8 million tons were produced in 1954, 9 million tons in 1955, 11 million tons in 1956 and 12 million tons in 1957. This level of production, however, is considered to be inadequate, particularly in view of the efforts now being made to cultivate vast areas east of the Urals where 36 million hectacres of land have been taken under the plough since 1954. The virgin fertility of these lands is fast becoming exhausted and considerable quantities of fertilizers will be required if their yields are to come up to expectations. Superphosphates account for over 50% of the fertilizer output and it is planned to expand fertilizer production to nearly 20 million tons a year by 1960, of which over 10 million tons would be in the form of superphosphate. By-product ammonium sulphate production is also to be raised, thus adding to the demand for acid. Uranium ore treatment is another activity which will increase the demand for sulphuric acid. Uranium mining, which is carried out on a considerable scale throughout the U.S.S.R., is to yield over 6,000 tons of metal a year by 1960.

Much of the current industrial expansion is taking place in Siberia where it is planned to increase production more than four times by 1965. Over 100 major plants are due for completion by 1960 and include five viscose pulp factories, seven man-made fibre plants and a large metallurgical plant at Taishet.

Sulphuric acid manufacture in the U.S.S.R. is expanding rapidly; 3.7 million tons were produced in 1955, 4.3 million tons in 1956, 4.6 million tons in 1957, and it is planned to raise production, at present at the rate of 4.8 million tons a year, to 7 million tons annually by 1960. It is intended to make all possible use of automation in order to raise acid production, and current Five Year Plan directives call for automation in new plants now under construction. At present 79% of the sulphuric acid produced in the U.S.S.R. is made from pyrites, 13% being made from smelter gases and 8% from brimstone. Plans for expansion are based on the further use of brimstone by exploiting Russia's considerable resources of native sulphur, and on the increased use of smelter gases. The U.S.S.R. is now the world's second largest producer of sulphuric acid from smelter gases, and practically all copper, zinc and lead smelting plants incorporate by-product acid facilities. An interesting new development has been the construction in the Donets Basin of one of the world's largest coking plants which incorporates chemical plant and a sulphuric acid unit. The Soviet Union claims to have the largest sulphur reserves in the world. Amongst sulphurous raw materials, the most important deposits are the iron and copper pyrites in the Urals and in Central Asia. Large deposits of pyrites containing some 2,000 million tons of sulphur are found in the Donets Basin but do not yet appear to be extensively exploited. Pyrites production, which was only 19,000 tons in 1913, had risen to 142,000 tons by 1929, 672,000 tons by 1933 and about one million tons at the outbreak of the last war. Brimstone imports have been increasing in recent years. The bulk of imported supplies originate from China who exported 52,000 tons in 1956 and about 70,000 tons in 1957, and from Italy whence deliveries were 7,000 tons and 19,000 tons respectively. Small scale exports to Finland, Czechoslovakia and other lesser Communist countries slightly reduced the tonnage available to Soviet industry. Important deposits of sulphur occur in the Kara-Kum Desert, 250 miles east of the Caspian Sea, on the Kertsch Peninsular and near Kuibyschev. An open-cast mine under construction at Kuibyschev, which was to be completed by 1963, is now to be brought into operation by 1961. It is reported that rich deposits of natural sulphur have recently been discovered in the Ukraine. These deposits are said to be up to 33 feet thick in places and

situated near the surface, thus allowing open-cast mining. There are about 20 sulphur mines in operation in the U.S.S.R. and production, which before World War II was at an annual level of 8,000 tons, is now about 120,000 tons a year.

Although the use of smelter gases and brimstone in sulphuric acid manufacture is being progressively increased and although that of pyrites can also be expected to expand, if less rapidly, no effective use is at present being made of sulphur in anhydrite. The most important reserves of natural gas in the U.S.S.R. are at Saratov (Ukraine) and Stavropol (Koubain) and these are being exploited for industrial purposes, but it is not at present known to what extent sulphur is being recovered. It is possible that sulphur will be recovered from crude oil but very little is known at present of the activities of the Russian oil refineries. In Siberia the natural gas supplies are inadequate to serve the considerable industrial expansion planned for that area and it is intended to create a gas industry based on the use of lignite, large reserves of which exist in Siberia. About 40 independent gas-making stations are being built as part of large, centralised gas-chemical combines situated near the mines. By-products at these combines include sulphur and it is to be expected that production of sulphur and sulphuric acid based on lignite will expand rapidly during the next five years.



Coke and chemicals section of the Cherepovets iron and steel works in the Vologda region.

Aware of the brake that a shortage of sulphuric acid is placing on its plans for industrial and agricultural expansion, the U.S.S.R. is energetically pursuing a policy of increasing the production of sulphuric acid making the best possible use of her extensive sulphur resources.

Company Reports

Società Montecatini S.p.a.

REVIEWING THE activities and financial results of Società Montecatini and associated companies for 1957, the Board found the record encouraging, particularly in the chemical field, although the Company's results in the mining and metallurgical sectors were in some cases disappointing. Attention was given to Italy's economic future which, in prevailing world conditions, is a little uncertain, but it was considered that there existed adequate safeguards, particularly the assurances given by the Government that, if necessary, the volume of public works will be increased. The closer integration of European industry resulting from the European Economic Community whilst bringing new problems was also, it was stated, a time for opportunity which Montecatini would take. Competition which had arisen with these developments had to some extent been aggravated by having to operate in fields where some competitors enjoy government privilege. By improved efficiency the Group had shown that it could withstand this pressure.

Finance

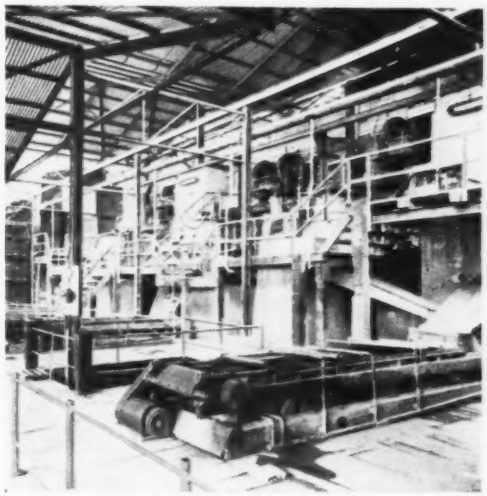
Net profit for the year 1957 rose to Lire 11,600 million (£6.7 million) from Lire 10,900 million in 1956, resulting from a rise (0.35%) in Società Montecatini's sales from Lire 152,042 million (£88.4 million) to Lire 152,574 million (£88.7 million). The better results from the nitrogen, explosives, petroleum, mining, paint and industrial chemicals divisions were to some extent offset by the decreased volume of sales in the metallurgical and agricultural chemicals division. Group sales, as opposed to those of Società Montecatini alone, rose by 8% to Lire 314,000 million (£182.5 million), results which include all those companies in which Società Montecatini has an interest.

Fixed assets rose from L.250,000 million (£145.3 million) to L.263,000 million (£152.9 million) an increase of L.13,000 million (£7.8 million) most of which was used for the purchase of new production equipment. The allowance for depreciation of fixed assets rose by L.12,000 million (£7.3 million). The ratio of Current Assets to Current Liabilities remained virtually the same at 2 : 83, with Current Assets increasing from L.108,000 million to L.116,000 million and Current Liabilities from L.38,000 million to L.41,000 million.

Stocks increased by L.6,731 million to L.47,885 million, nearly half the increase resulting from higher stocks of manufactured goods, whilst stocks of raw materials rose by L.1,722 million.

Pyrites

Pyrites production reached 1,312,000 metric tons against 1,200,000 metric tons in 1956, an increase of 9.3%. This total includes cupriferous pyrites from the mines at Fenice-Accesa and Boccheggiano and also the M.I.S.A.



The new beneficiation plant for iron pyrites produced at the Gavorrano mine.

mine at Libiola. In addition to improving working conditions at Gavorrano mines by the installation of a powerful ventilating system, important progress, it was stated, was made towards total mechanisation of the mine at Niccioleta. Development of the Boccheggiano mine was continued and additional machinery and equipment for the internal mechanisation of the mine were provided. The associated company M.I.S.A. increased production and raised the grade of copper ore output by improving flotation practice. The work which started in 1956 at Fenice-Accesa to double the

capacity of the flotation plant, was completed during 1957. Despite the weakness of the world sulphur market the search for new deposits of pyrites continued. Large ore bodies of high-grade pyrites were located in the Gavorrano region, particularly at Rigoloccio and Valmaggiore, and excellent results were achieved in the Niccioleta zone. At Boccheggiano underground drainage, by way of the extensive tunnel built in recent years, allowed the opening of several new fields.

Native Sulphur

The Italian native sulphur industry is now completely dominated by a condition of chronic weakness which, the Report states, is steadily worsening, due to additional sources of sulphur being developed throughout the world. The Report continues that it is difficult to visualise how legislation can help the industry when the problem is no longer domestic. In 1957 Italian production of melted raw sulphur amounted to 174,000 metric tons, a slight increase over the previous year. Production, including throughput from the Stincone deposit of the associated S.M.A.P.S., totalled 33,267 metric tons of melted raw sulphur and 181,412 metric tons of ore, the corresponding figures for 1956 being 25,984 metric tons and 270,409 metric tons respectively. The reduction in ore output is reported to be due to mining costs comparing unfavourably with "other sulphur bearing ores and especially pyrites." Use of brimstone in Montecatini's acid plants at Formignano and Perticara, which was only a temporary expedient, has been replaced by pyrites. The Montecatini-Lurgi furnace at Passarello is now stated to be working satisfactorily, after operating difficulties had been eliminated. The management therefore expects to obtain a satisfactory yield and quality of products in future operations.

Sulphuric Acid

Total production of sulphuric acid in 1957 amounted to 1,227,569 metric tons (100% H_2SO_4). Due to lower demand for chamber and tower acid, production by these installations has been reduced and in some cases suspended. Contact plants operated to capacity in response to the demand for monohydrate acid and substantial exports. There is a surplus of sulphuric acid output and for certain parts of Italy the Report forecasts overproduction in the near future. The Company proposes to use the interval while the balance of the sulphuric acid market is redressed to improve the plants with a view to lowering acid production costs.

Fertilizers

Production of phosphate fertilizers was reduced in 1957 by 3.1% to 1,228,012 metric tons due, it is stated, to the saturation of the market. New plants for the production of ammoniated superphosphate (4:16) started operation in 1957 at Crotone, Castel Guelfo, Piano d'Orta and Castel Fiorentino, bringing the total number to nine.

Construction of new nitrogen plants, particularly by ANIC and Soc. Edison, have increased Italian capacity to 620,000 metric tons (N), whilst domestic consumption in 1957 amounted to 280,000 metric tons. Although exports rose to 137,000 metric tons (N) in 1957 the Company considers it unlikely that they will increase further. It is, however, intended to continue operating Montecatini's plants at full capacity.

The programme for complex fertilizers has been continued and two more plants, in addition to those at Vercelli and Castel Guelfo, are being built at Barletta and Porto Marghera. Production of high-grade ternary fertilizers and triple superphosphate has been further increased at Crotone and Porto Empedocle.

Oil and Gas

Operations in the search for oil and gas continued with reasonably encouraging results. However, efforts in this field are still hampered, it was stated, by the law on exploration and development, which it is difficult to justify.

Other Activities

In the field of industrial chemicals, encouraging results were achieved, particularly in plastics, where the success of the polypropelene "Moplen" was considerable. Several new plants began operation during 1957, including those at Novara for production of methanol and ammonium nitrate for industrial uses, and a large plant for tripolyphosphate and sodium pyrophosphate at Linate. The capacity of the Spinetta Marengo titanium dioxide plant is being increased, whilst the Crotone plant producing phosphoric acid is being modernised to meet growing demand. Licences for the use of the Montecatini process and equipment for the manufacture of synthetic ammonia and nitric acid are being issued to many parts of the world.

Compania Espanola de Minas de Rio Tinto

THE REPORT on the activities and results of the Compania Española de Minas de Rio Tinto, S.A., for the year 1957, announces that results in both mining and smelting departments were satisfactory.

Trading profits for the year amounted to 203,233,347 pesetas (£1,728,000)* and a dividend of 7% was declared. Company tax totalled 56,460,899 pesetas (£480,000), whilst 47,613,122 pesetas (£405,000) were transferred to various reserves.

Continuing the company's policy of development, preparatory work for the underground exploitation of the San Dionisio ore body has proceeded satisfactorily, the overburden removal at the Atalaya open-cast mine has progressed as forecast and operations at the Alfredo mine are being rationalised. Permission has been obtained for the construction of a sulphuric acid plant utilising the exit gases from the Orkla smelting furnaces. All the ancillary services of workshops, electricity and transport functioned satisfactorily.

Domestic sales of pyrites increased in volume by 21% during 1957. The domestic price of pyrites, which was increased in January to pesetas 266.60 (£2 5s. 0d.), is stated by the Report to be still too low due to the continued general rise in costs. During 1958 the situation has deteriorated further, and it is believed by the Board that a general revision of pyrites conditions of sale in the domestic market is absolutely necessary, in order to provide a sound and equitable basis for the pyrites mining and processing industries.

Sales of copper have been satisfactory, although here again there is a rapid increase in the cost of production, mainly due to a rise in the price of fuel.

In 1957 exports of pyrites were maintained at the high level reached in 1956, lower shipments to Holland and Belgium being compensated for by increased sales to Italy, France and England. These results, it is stated, are particularly satisfactory as they were achieved in the face of growing competition from elemental sulphur. The reduction in price of American sulphur together with the greater fall in trans-Atlantic than in European freights and the low international prices for metals, increased difficulties in the pyrites industry. Consequently the major European producers reduced their prices in the second half of 1957 and again in January, 1958.

The Report went on to examine the future of the industry. In the long-term view, it was stated, the European market for sulphur would change, although the exact nature of the factors responsible was difficult to foresee. The pyrites mines, especially those in Spain and Portugal, would be able to supply a first-class product to the European market, supplying not only sulphur but also metals, particularly iron. It was largely upon this that the Board took an optimistic view of the future. In the field of metallurgy the support of German industry, headed by Duisburger Kupferhütte, in the treatment of cinders is valuable, and cordial relations are maintained with these manufacturers. However, the Report stated, much could be achieved at home by a more realistic domestic price, a sufficiently flexible exchange rate, modernisation of equipment and port installations. The industry is already taking steps in these matters to improve its position in international competition.

Sn. D. Antonio de Torres Espinosa, Director General of Minas de Rio Tinto, S.A., has been elected President of the Pyrites Residues Organisation for 1958.

Courtaulds Limited

DURING THE YEAR ending 31st March, 1958, the activities and results of the Courtaulds Group were adversely influenced by severe competition, rising costs, changes in the pattern of trade and world surplus of productive capacity in the man-made fibres industry. Indicative of the difficulties of the industry is the considerable deterioration in the financial results of the Courtaulds Group for the year ending 31st March, 1958, which were presented by the Chairman, Sir John Hanbury-Williams. Before deduction of tax, trading income at £13,918,000 — including £660,000 from the newly added British Celanese Limited — was

*Pesetas 117.60 equivalent £1

£1,200,000 lower than last year. If the results of both companies are compared with the preceding year — as British Celanese Limited showed a decline of £940,000 from 1956 — the decline in Group trading income would be £2,800,000.

The acquisition by Courtaulds Limited of British Celanese Limited provided an opportunity for the integration of activities which in many fields were complementary. The company report states that by the end of the year the concept of two groups had disappeared and the benefits of the merger were being felt. Progressively the approach to selling, marketing and development is being rationalised and the best use is being made of the managerial and technical skills in both companies. Production of acetate, plastics and associated chemicals is under the control of British Celanese Limited and although the decline in British Celanese Limited's operations continued, the Directors believed that the current financial year would see an improvement in earnings.

The results of Courtaulds' Associates and Subsidiaries, overseas and at home, reflect the different conditions in the world man-made fibres industry. Outstanding at home was British Nylon Spinners Company Limited whose activities and trading results were buoyant. Outside the fibres field British Cellophane Company's results gave evidence of a year's operation at full capacity and the achievement of a new high level of sales. Both companies in their specific spheres are engaged on major expansions of their plant and capacities; the new cellulose film plant of British Cellophane at Barrow, Lancs., is nearing completion and the first part is due to be in production before the end of this year. This contrasts with the situation in the filament rayon yarn sector where weak trading coupled with greater technical efficiency led to a re-appraisal and concentration of manufacturing capacity resulting in the closure of Courtaulds' Aber works at Flint in December, 1957, and short-time working elsewhere. There has been little change in the first six months of 1958 and production of the industry by June was 21% lower than a year earlier, and during the second quarter deliveries fell by 2.3 million lbs., compared with the corresponding quarter of 1957. Reflecting this, total non-acid sulphur consumption in the United Kingdom, which is governed by the demand of the rayon industry, is estimated to have fallen by 11,000 tons during the year ending June, 1958.

Despite recent set-backs, viscose and acetate filament yarns have a permanent and important part to play in the textile industry. Their place will be determined by their suitability in new uses and the scope of modified

General view of the recently completed Great Coates viscose rayon factory at Grimsby.

fibres with new properties. Viscose staple fibre, the United Kingdom manufacture of which is now focussed on Courtaulds' new plant at Grimsby, as well as at the large Greenfields plant near Manchester, has shown greater versatility of application and in consequence more resistance to recession.

The greater part of the capital of the Courtaulds Group is committed in the textile industry and the drawback of this is now evident. Whilst it is recognised that the industry is subject to much fluctuation, opinion is now held that mere rationalisation in textile industry will not be sufficient to bring about a permanent improvement in the fortunes of companies almost wholly dependent on the textiles and fibre market even including synthetic fibres such as nylon, terylene, acrylic fibres and others which have contributed in no small measure to the need for the readjustment in the man-made fibres industry. With this in mind the Courtaulds Group, whose active interest already extends to chemical and allied industries, is embarking on a policy of broadening still more the base of operations.

At present the chemicals interests of the Group are in two categories, those for use in industrial processes and those forming part of end-products such as emulsion paint, pharmaceuticals, cosmetics and fine chemicals. In order to promote more actively the process of diversification in the United Kingdom and abroad, a subsidiary company, Group Developments Limited, was established in January of this year. As one of the largest producers in the United Kingdom of sulphuric acid and carbon disulphide, coupled with comprehensive research facilities, world-wide trade connections and engineering experience and, above all, a strong liquid cash position, the Courtaulds Group has a valuable and probably unique basis for continued expansion and renewed prosperity.

Current Events

UNITED KINGDOM

Simon-Carves Ltd.—New Plant Contracts

Recent contracts secured by *Simon-Carves Ltd.*, of Cheadle Heath, Stockport, include two brimstone burning units for French manufacturers and one for Malaya.

The two plants for France, which have been sub-contracted by S. A. Heurtey, are a 100 tons per day installation for Soc. Finalens at La Bassée and a 20 tons per day plant for Soc. Meridionale de Produits Chimiques Agricoles at Avignon. The latter is expected to be completed during next year and will replace the present pyrites roasting furnaces. The plant for Malaya Acid Works Ltd. is a sulphur burner with a daily capacity of 10 tons of sulphuric acid (100% H_2SO_4). Civil engineering work at the site in Kuala Lumpur has commenced and Simon-Carves are currently preparing shipment of the various plant components.

Esso Refinery at Milford Haven

A new oil refinery with a capacity of 100,000 barrels a day is to be built by *Esso Petroleum Limited* at the deep water port of Milford Haven in Wales. A contract has been signed with Foster Wheeler Limited for the construction of the refinery which will be built on the site of 350 acres and will be served by a 3,500 foot jetty capable of accommodating 100,000 tons super tankers. Present indications are that the first phase of construction will take a little over two years to complete and that a construction force of up to 2,000 will be employed. It is intended to expand the refinery to a capacity of 250,000 barrels a day by 1965, bringing the eventual cost to about £95 million.

It is expected that a sulphur recovery plant will be built with a capacity of about 24,000 tons a year which in time would be expanded to an annual capacity of 45,000 tons of high purity brimstone. At present the combined sulphur recovery capacity of oil refineries in the United Kingdom is approaching an annual level of 100,000 tons. A sulphur recovery plant at Milford Haven would increase this capacity by one-third and would eventually raise it to over 140,000 tons a year, a tonnage equal to more than one-third of the total brimstone consumed in Great Britain during 1957 and therefore a significant factor in the country's economy.

AUSTRALIA

Tasmanian Sulphur Deposit

The Press announcements earlier this year of a rich deposit of sulphur in northern Tasmania is now authentically reported to refer to a deposit of black pyritic shale containing an average of 15% sulphur. This deposit, which has been under examination since 1954, is considered extensive. In laboratory tests ore has been concentrated to 47.5% sulphur but so far no plans for commercial exploitation have been reported.

Sulphuric Acid Production, January-June, 1958

Total production of sulphuric acid during the first half of 1958 totalled 525,976 tons (100% H_2SO_4) compared with 429,624 tons in the corresponding period of 1957, a rise of 22½%. Chamber acid plants account for 60% of total production, the high proportion being due to the predominant use of chamber acid in the manufacture of single superphosphate. Actual production of contact acid has increased only 8,000 tons to 212,240 tons, but it is anticipated that in the second half of this year the trend will be accelerated, following the completion of a 110 tons per day acid plant

for Mary Kathleen Uranium Mines, and the commissioning of the third by-product acid plant for the Electrolytic Zinc Co. of Australia Ltd., at Risdon, Tasmania.

Of the total acid produced, 271,465 tons (50%) was from the use of sulphur, 153,450 tons from the roasting of pyrites and 54,174 tons from SO_2 in smelter exit gases at zinc plants, the remainder being produced from spent oxide, lead concentrates and regeneration of sludge. Consumption of elemental sulphur in the first half of the year for acid production, increased by nearly 5,000 tons to 92,748 tons, while pyrites usage declined 6,000 tons to 123,529 tons. By-product acid from zinc concentrates rose by 11½%, while advances were maintained in the use of all other sulphurous raw materials. Sulphuric acid manufactured from the use of indigenous raw materials rose to 48.8% in the first half of 1958, fractionally (0.6%) more than in the corresponding period last year.

It is estimated that of the total acid production 80% (420,000 tons) was consumed in the manufacture of some 1,185,000 tons of superphosphate in the first half of 1958, slightly more than in 1957. The sustained demand for acid has also been noticeable in the industrial sectors and is now estimated to be running at an annual rate of 110,000 tons.

The Sulphur Bounty is to be reviewed by the Tariff Board in 1959. In the past 12 months the low landed cost of imported brimstone has resulted in a high subsidy to pyrites acid makers which, at the above rate of output, imposed a serious financial burden on the Government. In view of the vastly changed circumstances, both in the overall world pattern of elemental sulphur availability and the necessary expansion of the Australian sulphur industry, it is important that the Government should determine where subsidies are most required. The indications are that it will be less needed in the sulphur sector than applied to selected producers in the non-ferrous ore mining field.

UNITED STATES

Refinery Expansion

Expansion of the Beaumont, Texas, refinery of the *Magnolia Petroleum Co.* is centred round a highly mechanised new blending and packaging plant handling some 120 different products. In the company's scheme six major refinery units have been added which include an alkylation unit, a 30,000 barrels p.d. Sovafiner hydrogen sulphide removal unit, a plant for the recovery of H_2S from liquid and gas feed stocks going to the new alkylation unit in addition to a major crude oil distillation unit. Hydrogen sulphide is recovered in a sulphur recovery unit which has a rated capacity of 70 short tons per day. Production was scheduled to commence in September when start-up operations on the various hydrogen sulphide producing units had been completed satisfactorily.

Fremont Minerals Inc. to make Sulphuric Acid

A sulphuric acid plant, with a capacity of 100 tons (100% H_2SO_4), is being installed at the uranium processing mill now under construction for *Fremont Minerals Inc.* at Riverton in the Gas Hills area of Wyoming. The plant will be a Monsanto contact acid installation and will burn brimstone purchased nearby at Worland, Wyoming, where sulphur is recovered by Texas Gulf Sulphur Co. from sour gas and sold in liquid form.

The uranium mill is designed to consume approximately 22 tons of 66° Bé acid per day, and Fremont Minerals Inc. intend to sell their surplus acid production to other uranium processing mills in Central Wyoming. The Riverton uranium mill will be the first to manufacture its own requirements of sulphuric acid in an area where uranium production is rapidly growing.

BELGIAN CONGO

Union Miniere du Haut Katanga

Production of zinc blende at the Kipushi concentrator in 1957 amounted to 188,183 metric tons containing approximately 56,000 metric tons of sulphur and was 6.5% lower than the 1956 output of 203,772 metric tons, containing approximately 61,000 tons of sulphur. Part of this production is now being stock-piled to cover the company's sulphur requirements when, in the next few years, the Prince Leopold mine becomes exhausted.

The associated Societé Générale Industrielle et Chimique de Katanga at Jadotville roasted 139,103 metric tons of zinc concentrates during the year producing 95,360 metric tons of sulphuric acid (100% H_2SO_4) compared with

90,700 metric tons (100% H_2SO_4) in 1956. Metallurgical uses—leaching and electrolysis—consumed 89,300 metric tons (100% H_2SO_4) compared with 86,900 metric tons (100% H_2SO_4) in 1956. It is estimated that approximately 18% or 16,000 metric tons (100% H_2SO_4) of total sulphuric acid consumption was used in the treatment of uranium ore during 1957. Exports of calcined zinc concentrates to Belgium amounted to 72,707 metric tons against 71,976 in 1956, whilst 87,242 metric tons were sold to Metalkat for the production of electrolytic zinc compared with 74,433 metric tons in the preceding year. No crude zinc blende was exported. The Kolwezi concentrator treated 3 million tons of copper and copper-cobalt oxide ores and mixed oxide sulphide ores from the mines of Musonoi, Ruwe, Kamoto and Kolwezi. The intensive investigations of new methods of treatment of these ores have been resumed. At Kolwezi, in the course of the pilot plant work, modifications have been completed on the pulp preparation section and on treatment of the ores in a fluidised bed furnace. The new plant permitting the direct production of a solution of copper and cobalt sulphate suitable for electrolytic metals recovery and acid regeneration is reported to show improved results and full-scale operation is expected to start in 1960.

SPAIN

Sulphur and Sulphuric Acid 1957

Sulphur production in 1957 totalling 47,541 metric tons failed to reach the previous year's record level of 52,699 tons. A decline of some 2,000 tons was accounted for by Azufres de Lorca S.A., who only produced 888 tons of refined sulphur from native ore, while the recovered sulphur plant of Real Cia Asturiana de Minas produced 7,879 tons, some 2,300 tons less than last year. Details of productions were as follows :—

	1956	*1957*
Coto Minero de Hellín S.A. ...	2,555	2,574
Cía Española de Minas de Rio Tinto S.A.	36,600	36,200
Azufres de Lorca S.A.	2,834	888
Real Cia Asturiana de Minas ...	10,299	7,879
La Industrial Quimica de Zaragoza	392	—
	52,669	47,541

Sulphuric acid production of 945,647 metric tons (100% H_2SO_4)—compared with 924,475 tons in 1956—increased to a new peak. Closely geared to the demands of the fertilizer industry, the sulphuric acid sector has, however, not been as buoyant as anticipated. This has affected only the smaller producers, while the large manufacturers, notably S.A. Cros and Union Española de Explosivos, have continued their modernisation and expansion schemes.

Overall capacity of the sulphuric acid industry rose by 55,000 tons in 1957 to 1,165,500 tons. New chamber plants were completed for Union Española de Explosivos at the San Jeronimo works where the new 10 tons per day plant raises annual capacity to 12,290 tons (100% H_2SO_4), and also for La Industrial Quimica de Zaragoza who have commissioned the first of the two 12 tons per day units scheduled to be built at Zaragoza. Union Española de Explosivos also brought into operation, in the spring of 1957, a new 100 tons per day contact acid plant at Cartagena, Murcia, which is capable of producing 67%, 98% acid and oleum (104/5%), and is designed to meet the company's growing requirements in this province. Soc. Navarra de Industrias have also made considerable progress at their works at Lezo, Guipuzcoa, where a 33 tons per day plant entered production in 1957. Capacity at this location now totals 24,000 tons per annum and is due to be supplemented by an additional plant with an annual capacity of 10,000 tons.

New projects which received the approval of the Instituto Nacional de Industria were four chamber plants for S.A. Cros—Coruna, and Maliano (Santander), San Juan de Aznalfarache (Seville), and S. Carlos de la Rapita (Tarragona)—with a joint annual total capacity of 47,000 tons and a new 26,000 tons per annum contact plant for Quimica Industrial de Capuchinos S.A., Rentaria, Guipuzcoa.

Of the total sulphuric acid produced in 1957, 34% was made by the contact process. This compared with 31½% in the previous year and only 12% in 1950. This trend will become more noticeable as several large contact plants —part of the scheduled new 1,045,000 tons contact acid capacity programme contrasting with only 178,000 tons of projected chamber plants—enter production. It is anticipated that sulphuric acid production in 1958 will total one million tons, making Spain the eleventh country in the world to exceed this figure.

MOROCCO

Pyrites Production

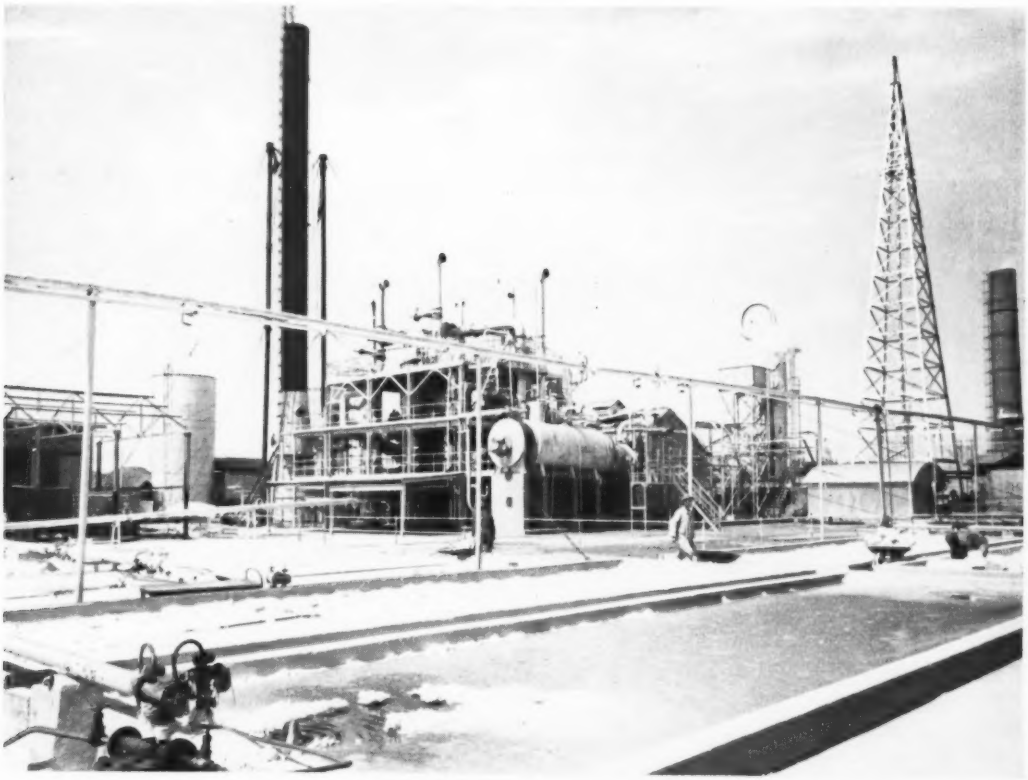
In 1957 the output of pyrites totalled 6,260 metric tons and was derived wholly from El Ketarra deposit. Last year the output from this mine had totalled 511 tons and had been supplemented by 706 tons produced at Rehamna. This latter mine was closed in the middle of 1956. Production from the El Kettara deposit, which is a low grade pyrites ore body, estimated at several million tons, has been recently expanded following modernisation and is consumed domestically by Société Cherifienne d'Engrais et de Produits Chimiques at Casablanca.

IRAN

Sulphur and Sulphuric Acid, 1957

Sulphur production in 1957 totalling 18,000 tons resulted from the activities of the *Iranian Oil Operating Companies* in connection with oil exploration and production and refining operations. *The Iranian Oil Exploration and Producing Company* recovered 11,000 tons of brimstone from natural gas and the separation and cleaning of hydrogen sulphide gas and crude oil. At Aghi Jari and Gach Saran well heads oil/gas separation facilities have been installed, but it is believed that the H_2S is being flared off. Production at these locations will be increased over the next two years by the installation of additional gas/oil separation units with an estimated treatment capacity of 450,000 barrels.

Production from the refining operations of the *Iranian Oil Refining Company* resulted in some 7,000 tons brimstone being recovered in 1957, approximately double that of the previous year. The Abadan Refinery, which processed an average of 314,000 barrels per day of crude oil, 34% more than in 1956, is constantly being enlarged and modernised, and in addition to the completion of new kerosene storage and loading facilities, a new pipeline section for the gathering of hydrogen sulphide was installed.



Sulphur vats at the Bibian sulphur and topping plant at Masjidi-i-Sulaiman, South Iran.

Sulphur which is consumed in the Company's own sulphuric acid plant was supplemented by about 15,000 tons imported from the United States. Actual sulphuric acid production was 77,000 tons, while an additional 30,000 tons was regenerated from spent sulphuric acid.

JAPAN

Sulphuric Acid 1957

Production of sulphuric acid in 1957 totalling 3,932,302 metric tons (100% H_2SO_4)* continued the upward trend which since 1950 has shown an average annual expansion rate of 12%. The actual increase over the previous year of 237,400 tons (6½%), however, represents a slowing down of the tempo of the industry following the completion of an intensive construction programme. The most significant progress continues to be made in the utilisation of stack gases at copper and zinc smelters and production from this source totalled 589,295 tons, just over 100,000 tons more than in the previous year. The new Lurgi 220 tons per day contact sulphuric acid plant of the Mitsubishi Metal Mining Co. Ltd. at Naoshima is one of the most important developments in this sector in 1957; at the same time older by-product chamber installations were closed. Overall production from contact installations, however, rose by 10% while there was an actual decline of chamber acid output by 62,000 tons to 1,486,663 tons (100% H_2SO_4) representing nearly 38% of total acid manufacture in 1957. Sulphuric acid produced from the use of pyrites and sulphur ores totalled 3,343,007, 4¼% more than in 1956.

The pattern of raw materials consumption has not changed appreciably. Of the total acid production 85% originated from the use of iron pyrites, pyrrhotite and sulphur ore. Although consumption of iron pyrites and pyrrhotite rose by ¾% and 15½% respectively, the use of sulphur ores for acid production declined 42,000 tons to 707,000 tons due to the larger requirements of sulphur refiners. The increased use of copper concentrates, which in 1957 reached 194,000 tons, are partly met by domestic supplies but increasingly from the Philippines, where the Atlas Mining Consolidated and Development Corp. have an agreement with the Mitsubishi Metal Mining Co. to supply 10,000 tons of copper concentrates per month and where new copper producers are developing properties with a view to supplying the Japanese market.

Two-thirds of the total acid consumption of 3,924,735 tons was used in the manufacture of fertilizers. Increased use in the nitrogenous fertilizer sector continued as plants have been expanded and new units commissioned, while in the phosphatic fertilizer industry a decline has been recorded, the first since 1946. All major consumers of acid have increased their consumption, notably man-made fibres, the iron and steel and the petroleum industries.

It is anticipated that in 1958 the expansion phase of the sulphuric acid industry will be slowed down, if not arrested, and that at best production may be expected to reach four million tons, an increase of only 2%. The uncertain position of the export market for fertilizers, coupled with a declining production of rayon in 1958, is likely to lead to some reduction in acid consumption in these sectors. The rising acid requirements by the inorganic chemicals, iron and steel, and the petroleum industries are, however, expected to continue.

* For further details see Statistical Appendix.

Statistical Appendix

Pyrites Exports 1957

Thousand Metric Tons

	Spain	Cyprus	Norway	Portugal	Yugoslavia	Greece	Sweden	Italy
Algeria	19.8	—	—	2.1	—	—	—	—
Austria	9.4	—	—	—	9.4	14.7	—	46.1
Belgium	160.1	15.0	—	94.8	—	—	—	—
Czechoslovakia	—	14.4	20.7	—	40.2	73.6	29.8	—
Denmark	75.3	—	62.3	—	—	—	—	—
Eire	16.6	1.9	—	1.4	—	—	—	—
Egypt	37.3	8.4	—	—	9.6	19.5	—	—
France	193.1	138.5	5.0	66.2	—	—	—	—
E. Germany	—	—	62.7	—	3.0	1.9	17.6	—
W. Germany	527.0	303.1	160.0	41.6	18.7	11.5	10.2	—
Hungary	—	—	—	—	31.5	—	—	—
Italy	111.3	159.3	—	—	41.1	18.4	—	—
Morocco	—	—	—	2.3	—	—	—	—
Netherlands	191.3	181.2	11.9	76.4	—	44.2	—	—
Poland	—	—	15.2	—	34.1	3.0	30.0	—
Sweden	—	—	111.9	—	—	—	—	—
Switzerland	—	—	—	—	5.3	—	—	38.0
United Kingdom	93.8	182.6	—	9.2	—	—	13.5	—
Others	10.4	—	—	3.2	—	—	—	16.6
Total—1957	1,455.9	1,004.7	449.7	297.0	193.0	186.8	101.1	101.1
Total—1956	1,551	1,008.6	467.8	407.5	180.6	206.4	55.3	101.9

Mexico

SULPHUR PRODUCTION

Long Tons

		Pan American Sulphur Co.	*Gulf Sulphur Corporation*	*PEMEX and Texas Gulf Sulphur*	*Negociacion Minera de Azufre SA*	*Total*
1957	October	72,455	21,353	15,500	1,500	110,900
	November	66,905	19,783	12,500	1,000	100,188
	December	69,559	18,718	15,000	1,505	104,777
1958	January	70,627	18,940	22,800	1,200	113,567
	February	64,182	14,056	13,000	1,500	92,738
	March	73,743	21,945	10,721	1,500	107,909
	April	70,235	20,800	11,500	1,500	104,035
	May	78,221	18,983	11,777	1,575	110,556
	June	60,726	26,605	11,999	1,500	100,830
	July	54,843	27,664	12,500	1,500	96,507
	August	71,943	24,790	12,075	1,450	110,258

SULPHUR EXPORTS
APRIL—JUNE 1958

Metric Tons

	Pan-American Sulphur Co.	*Gulf Sulphur Corp.*	*Total 2nd Qtr.*	*Total Jan.-June*
United States	102,973	16,865	119,838	257,227
United Kingdom	11,937	—	11,937	23,978
France	22,574	9,923	32,497	55,554
South Africa	11,089	—	11,089	24,308
Australia	—	14,638	14,628	41,689
Netherlands	3,997	—	3,997	7,258
Tunisia	5,648	—	5,648	17,846
Germany	3,357	—	3,357	6,645
Belgium	1,994	—	1,994	3,061
Israel	—	11,941	11,941	14,482
Formosa	4,033	—	4,033	4,033
Canada	10,281	—	10,281	10,281
Sweden	3,201	—	3,201	3,201
Total :	181,083	53,358	234,441	469,562

United States

		PRODUCTION		STOCKS		EXPORTS	IMPORTS
		Frasch	*Recovered*	*Frasch*	*Recovered*		
1957		5,491,210	519,078	4,422,548	157,075	1,651,093	484,680
1957	April	461,589	37,650	4,049,025	122,006	171,258	43,897
	May	429,227	42,400	4,092,772	127,908	113,147	39,847
	June	439,513	44,867	4,086,614	144,753	172,977	24,638
	July	459,534	45,311	4,153,206	150,518	118,814	47,918
	August	469,987	46,705	4,173,199	153,478	161,337	42,053
	September	444,779	43,912	4,272,558	152,940	79,617	42,576
	October	462,145	47,299	4,304,891	154,566	163,430	32,076
	November	445,908	41,882	4,354,962	154,285	138,852	31,944
	December	471,630	48,098	4,422,548	157,075	152,788	77,047
1958	January	461,285	53,673	4,540,198	161,348	87,430	35,919
	February	415,186	49,174	4,620,606	163,793	103,376	45,422
	March	429,475	51,104	4,620,947	163,462	127,713	48,979
	April	402,581	46,195	4,638,320	165,363	144,117	20,072
	May	415,115	49,579	4,620,347	168,198	137,350	48,235
	June	383,664	48,039	4,661,649	160,873	167,949	27,875
	July	359,384	47,173	4,721,167	165,552		

Official Bureau of Mines Data (long tons of 2,240lbs.)

CRUDE SULPHUR EXPORTS

Long Tons

	2nd Qtr. 1958	*Jan.-June 1958*		*2nd Qtr. 1958*	*Jan.-June 1958*
Canada	80,956	111,869	S. Arabia	90	90
Guatemala	—	50	Israel	2,500	2,500
Cuba	5,800	5,800	Aden	100	100
N. Antilles	2,500	5,000	India	21,976	53,726
Costa Rica	—	22	Pakistan	629	924
Venezuela	595	991	Indonesia	2,900	3,900
Peru	2,000	2,000	Korea Repub.	141	370
Brazil	27,361	48,495	Australia	29,056	71,055
Uruguay	1,825	3,566	New Zealand	7,050	19,254
Argentina	17,794	18,778	Algeria	5,000	9,860
Austria	8,017	18,017	Canary Isles	984	984
United Kingdom	89,331	143,816	Union of South Africa ...	18,000	34,500
Belgium	26,480	49,830	Morocco	3,500	3,500
France	20,525	58,315	Lebanon	999	2,499
West Germany	28,499	41,819	Netherlands	5,250	—
Switzerland	28,755	30,455	Poland	—	2,500
Finland	9,654	9,654	Philippines	—	47
Yugoslavia	2,000	2,000			
Greece	999	999	Total	449,416	767,935
Iran	2,400	5,400			

Japan

SULPHURIC ACID

Acid produced from:—	1956			1957		
	Chamber	*Contact*	*Total*	*Chamber*	*Contact*	*Total*
Zinc Smelter Gases	58.9	149.1	207.9	45.2	191.1	236.3
Copper Smelter Gases	148.5	129.1	277.7	143.2	209.8	352.9
Sulphur Ores	1,341.5	1,867.8	3,209.3	1,298.3	2,044.7	3,343.0
Total '000 metric tons 100% H_2SO_4	1,548.9	2,146.0	3,694.9	1,486.7	2,445.6	3,932.3

Consumption of Raw Materials

Thousand metric tons

	1956	*1957*
Iron Pyrites	1,823.3	1,900.2
Pyrrhotite	182.5	210.4
Sulphur Ore	749.1	707.3
Zinc Blende	231.9	250.0
Copper Concentrates ...	123.1	194.5
Copper Pyrites	64.4	37.6
Others	2.7	2.7

Consumption of Sulphuric Acid

Thousand metric tons 100% H_2SO_4

Nitrogenous fertiliser	1,759.9
Phosphatic fertiliser	849.7
Artificial and synthetic fibres	518.9
Inorganic chemicals	239.5
Organic chemicals	79.7
Iron and steel	82.4
Petroleum	71.2
Dyestuffs and intermediates	35.3
Others	288.1
Total	3,924.7

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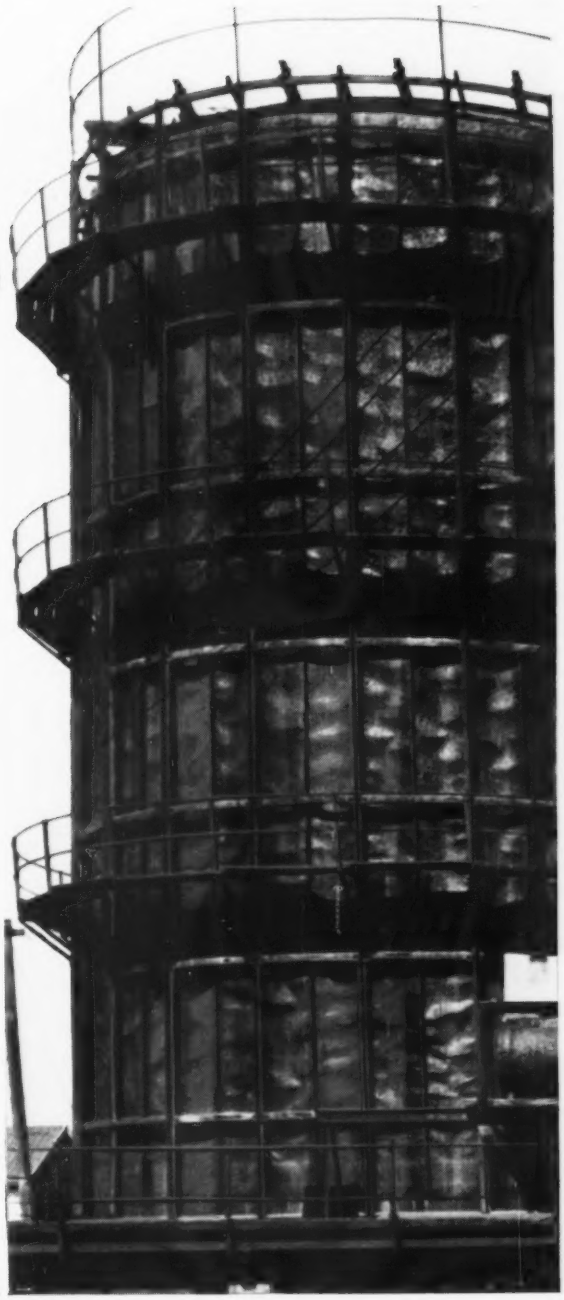

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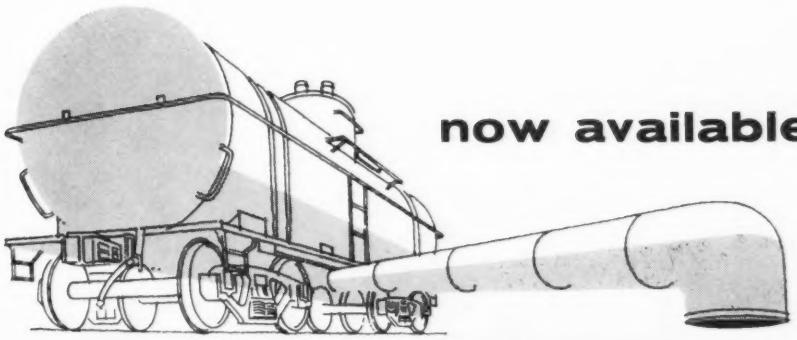

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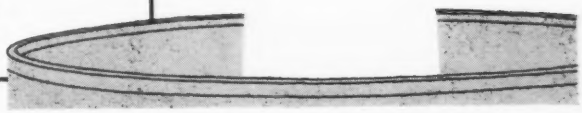

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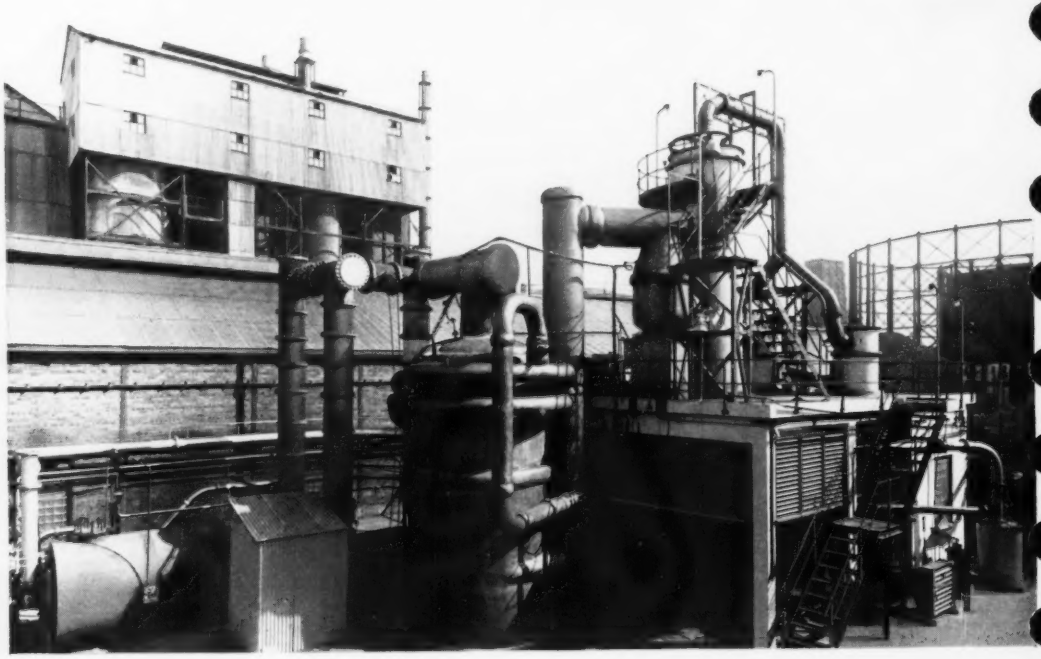
for sulphuric acid production from hydrogen sulphide



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